Progress Report

June 17, 2015

Steam Enhanced Extraction at the Former Williams AFB, ST012 Site

Mesa, AZ

1. Summary

This report covers the period of operations from Tuesday, June 9, 2015 through Monday, June 15, 2015. The following table provides a summary of the project operational status.

Table 1. Project Summary

	Value	Unit
Target Treatment Zone (TTZ) Soil Volume	410,000	cubic yards (cy)
Area	199,000	square feet (ft^2)
Upper Depth of Treatment	145	feet (ft) below ground surface (bgs)
Lower Depth of Treatment	245	ft bgs
Vapor Liquid Treatment Started	09/29/14	
Thermal Operations Started	09/29/14	
Last Process Data Update	06/15/15	
Last Temperature Data Update	06/15/15	
Estimated Total Days of Operation	422	days
Days of Operation	259	days
Days of Operation vs. Estimate	61	percent (%)
Estimated Total Energy Usage	11,343,000	kilowatt hours (kWh)
Total Energy Used	2,329,623	kWh
Used Electrical Energy vs. Estimate	21	%
Total Steam Injected	155.3	million pounds (lbs)
Projected Total Steam Injection	320	million lbs
Steam Injected Vs Projected	49	%
Total Mass Removed in Vapor Based on Photoionization Detector (PID) Readings	444,285	lbs
Total Mass Removed as NAPL	758,088	lbs
Average Daily NAPL Mass Removal Last Week	7,787	lbs/day
Total Vapor and Liquid Mass Removal (based on PID readings)	1,202,374	lbs
Average Power Usage Rate Last Week	477	kilowatts (kW)
Average Wellfield Vapor Extraction Rate Last Week	398	standard cubic feet per minute (scfm)
Average Condensate Production Rate Last Week	0.5	gallons per minute (gpm)
Average Water Extraction Rate Last Week	108	gpm
Total Water Extracted	39,482,118	gallons
Total Recovered Light Non-Aqueous Phase Liquid	115,211	gallons
Average Water Discharge Rate Last Week	164	gpm
Total Treated Water Discharge	51,170,000	gallons

Operational highlights from the past week include:

- Repairs at TMPs 06 and 09 were completed with the new monitoring arrays set at bottom depths of approximately 240 and 176-180 ft bgs, respectively. The TMP 09 array was set at a shallower depth due to obstructions experienced during installation. Data from TMP 17 were included in this week's temperature average.
- The pressure cycling in parts of the UWBZ continued (decreased injection in UWBZ SIWs: 3, 7, 9, 11, 12, 14, 16 and 25).

- The average steam injection rate in the LSZ was 21,600 lbs/hr (or 43.2 gpm).
- The average steam injection rate in the UWBZ was 5,800 lbs/hr (or 11.6 gpm).
- Beginning on May 26, 2015, six eductor skids were operated. The average liquid extraction rate from the formation was approximately 108 gpm.
- The average steam injection rate last week was 54.8 gpm. The net extraction from the formation was 97%.
- Collected process, wellfield and laboratory data per the sampling schedule.
- Conducted regular maintenance on the treatment system.
- The following MPE wells were confirmed as needing maintenance (please note that the cobble zone wells were identified this week during testing efforts of the cobble zone MPE wells prior to initiating steam injection in the cobble zone – the cobble zone wells were not a part of the original eductor well pump pulling and replacement):
    - LSZ-5* (previously identified as requiring maintenance)
    - LSZ-6* (previously identified as requiring maintenance)
    - LSZ-15
    - LSZ-30
    - LSZ-37*
    - UWBZ-5* (previously identified as requiring maintenance)
    - UWBZ-27*
    - CZ-09
    - CZ-13
    - CZ-15
    - CZ-17
    - CZ-18
    - CZ-8

  *MPE wells at steam temperatures – maintenance cannot be performed presently due to health and safety concerns

2. Vapor Extraction

Figure 1 below shows the vapor extraction rate from the site. Note that the estimated steam extraction rate is a calculated value based on the water generated at the moisture separators after cooling the vapors from the wellfield. Based on energy balance analysis, additional steam is likely being pulled into and condensing in the liquid extraction system. This steam extraction is not measureable and not accounted for in Figure 1. Additionally the wellfield flow is calculated as the difference between the air stripper flows and thermal accelerator influent, and is therefore only an estimate.

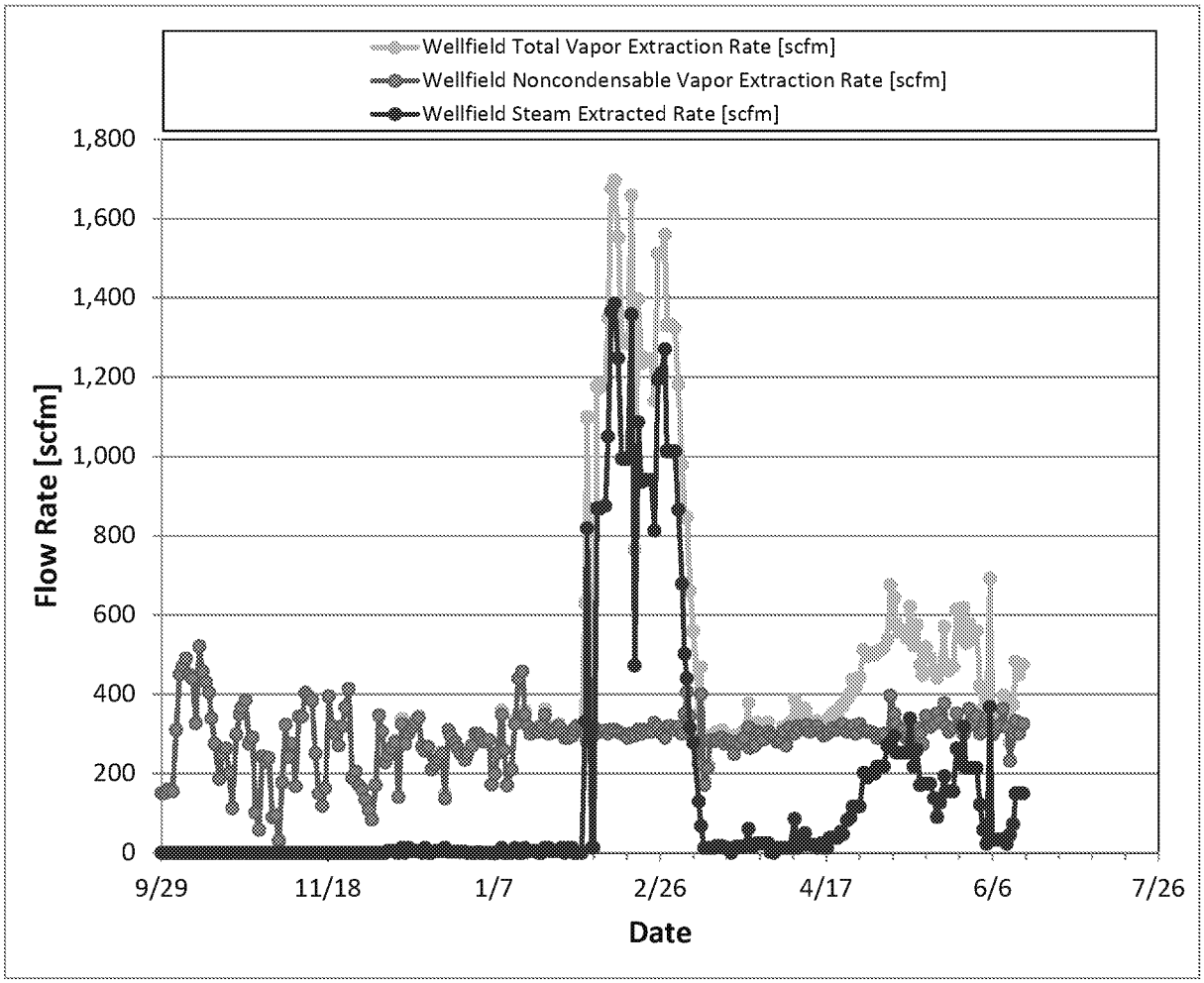

Figure 1. Vapor Extraction Rate

Note: Well SVE01M was tied into the SEE extraction system on June 5, 2015.

3. PID Measurements

The following figure depicts the PID concentrations from the wellfield effluent to the effluent of the thermal accelerators collected since the start of operations. Note that PID readings of 0.0 parts per million by volume (ppmV) are shown in the figures as 0.01 ppmV due to the logarithmic scale that does not allow display of 0-values. Accelerator influent readings are interpolated for days where no data is collected, since the value is used in the mass removal calculation.

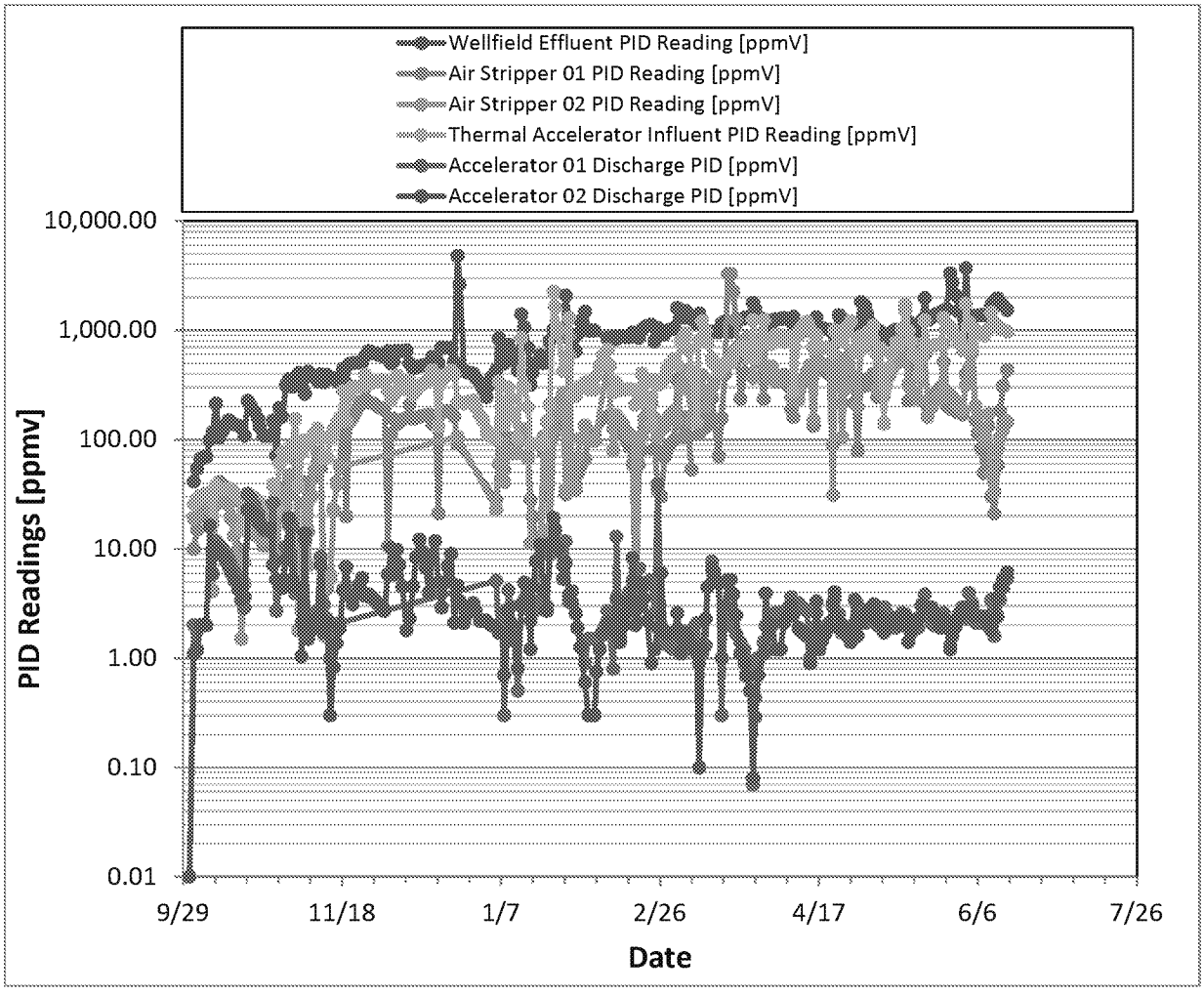

Figure 2. PID Readings

4. Mass Removal

The mass removal is calculated based on the PID and laboratory data collected at the thermal accelerator influent and the LNAPL recovered. The figure also depicts the mass removed based on PID and laboratory data. Please note that the mass estimate based on laboratory data and PID has been updated since last week based on the results of the vapor sample collected on May 6, 2015.

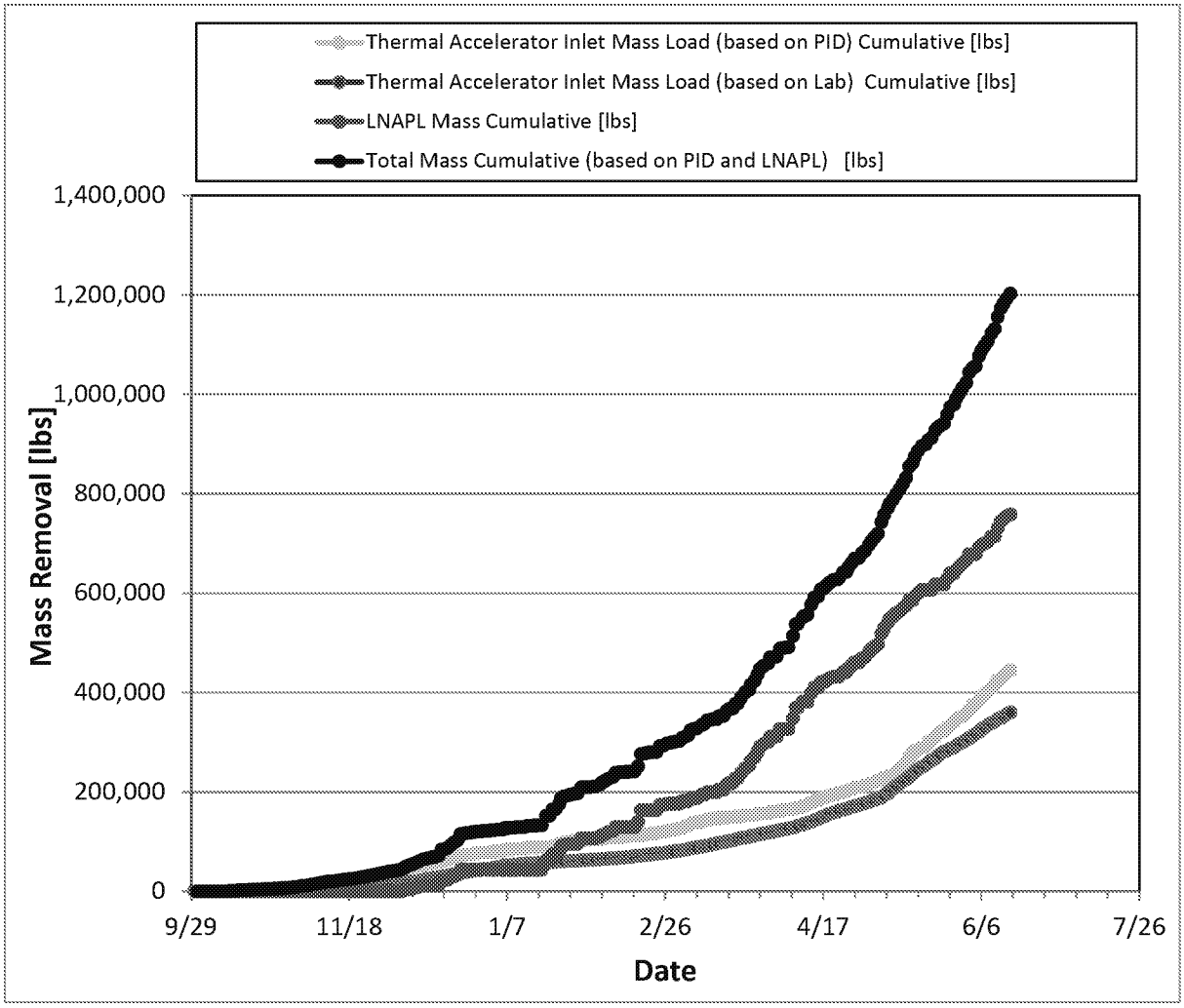

Figure 3. Mass Removal

Note: A NAPL density of 6.58 lbs/gallons was used to convert the NAPL volume to pounds.

5. Daily Mass Removed

Figure 4 outlines the daily mass removed as vapor and LNAPL. The total daily mass removed is the combination of vapor and LNAPL. The liquid mass removal is captured in the vapor phase due to the volatilization of liquid contaminants in the air strippers.

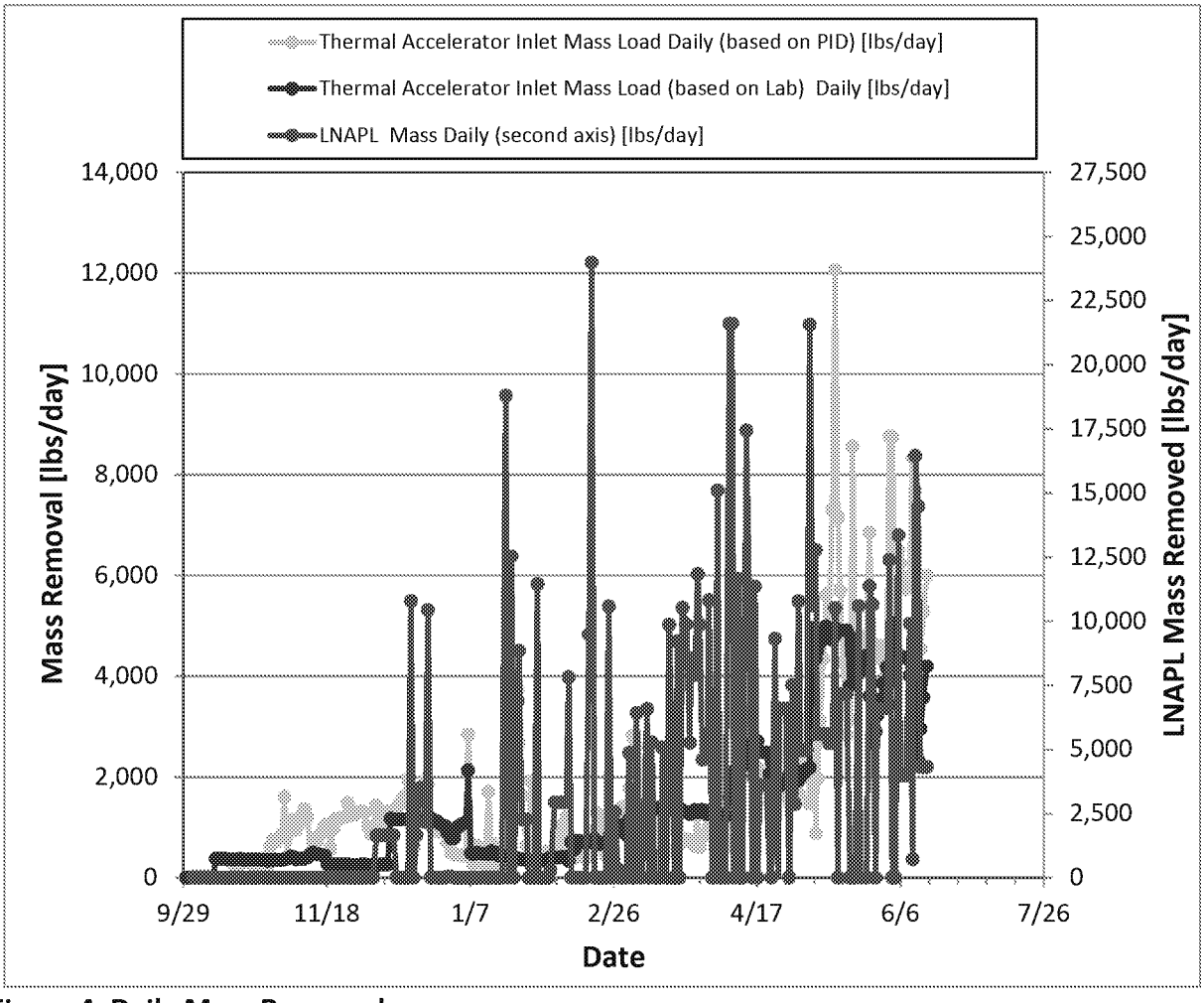

Figure 4. Daily Mass Removed

Note: Laboratory data are not collected daily. The "Thermal Accelerator Inlet Mass Load (based on lab)" is an average daily rate of actual lab data collected. Note that accumulated LNAPL is pumped through the NAPL conditioning system in a batch style process.

6. Power Usage

The cumulative power usage is shown below. All electricity used at the site is utilized to run the process system and steam generators.

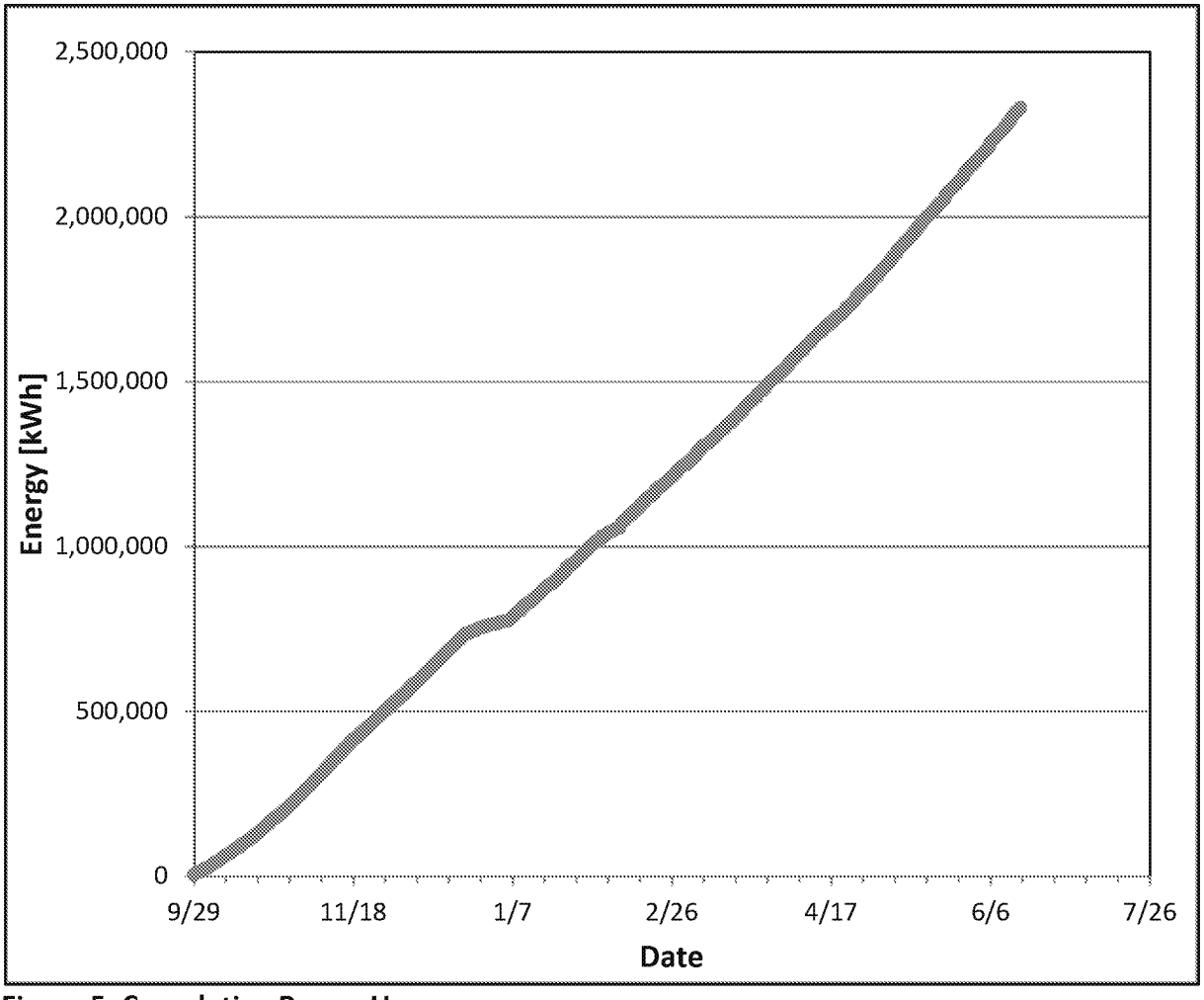

Figure 5. Cumulative Power Usage

7. Average Temperature

The average soil temperatures as degrees Celsius (°C) and degrees Fahrenheit (°F) are shown in the figure below by treatment zone (i.e., LSZ, UWBZ and Cobble Zone [CZ]). Please note that five temperature monitoring arrays (TMPs 01, 05, 06, 07, and 09) were offline during this operational period, and therefore the temperatures from these wells have been excluded in the average temperature calculations. TMP 17 data were added back into the temperature average during this operational period.

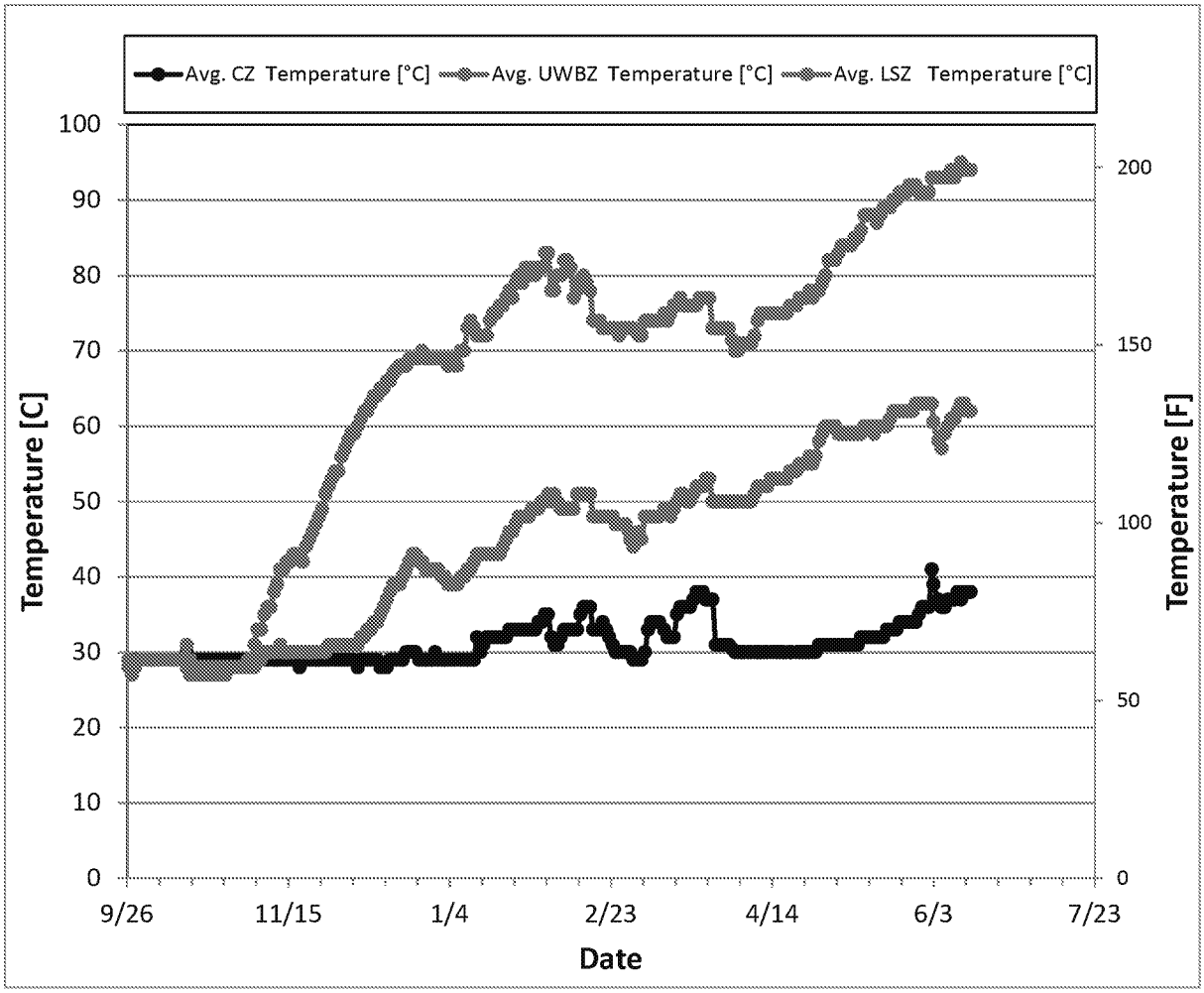

Figure 6. Average Soil Temperatures

Note: The replacement sensors installed in TMPs 06, 07, and 09 are not reading correctly and require additional troubleshooting; therefore, the temperatures have not been included on this figure. Repairs to TMPs 01 and 05 are scheduled for this week.

8. Vertical and Horizontal Temperature Profiles

The following Figures 7 and 8 show the temperature in °C versus depth profiles for each of the 17 individual temperature monitoring points (as stated above, TMPs 01, 05, 06, 07, and 09 were offline during this operational period). Figures 9-12 show the horizontal temperature distribution across the site in four depth intervals.

Temperature highlights for the past week include:

- The heat up rate at perimeter well TMP 2 at 215 ft bgs has decreased by 1°C the past week and is now at 59°C.
- TMP 4 has cooled at the bottom 235 to 242 ft bgs depth.
- TMP 10 shows steam temperatures in the 210 to 230 ft bgs interval.
- TMP 11 has cooled down in the 170-175 ft bgs interval from steam temperatures (110 °C) to approximately 88°C.
- TMP 12 has seen an 11°C increase in the UWBZ to 54°C at the 175 ft bgs depth.
- TMP 15 has seen some small increases at the 185 and 195-200 ft bgs depths over the last week – approximately 10°C.

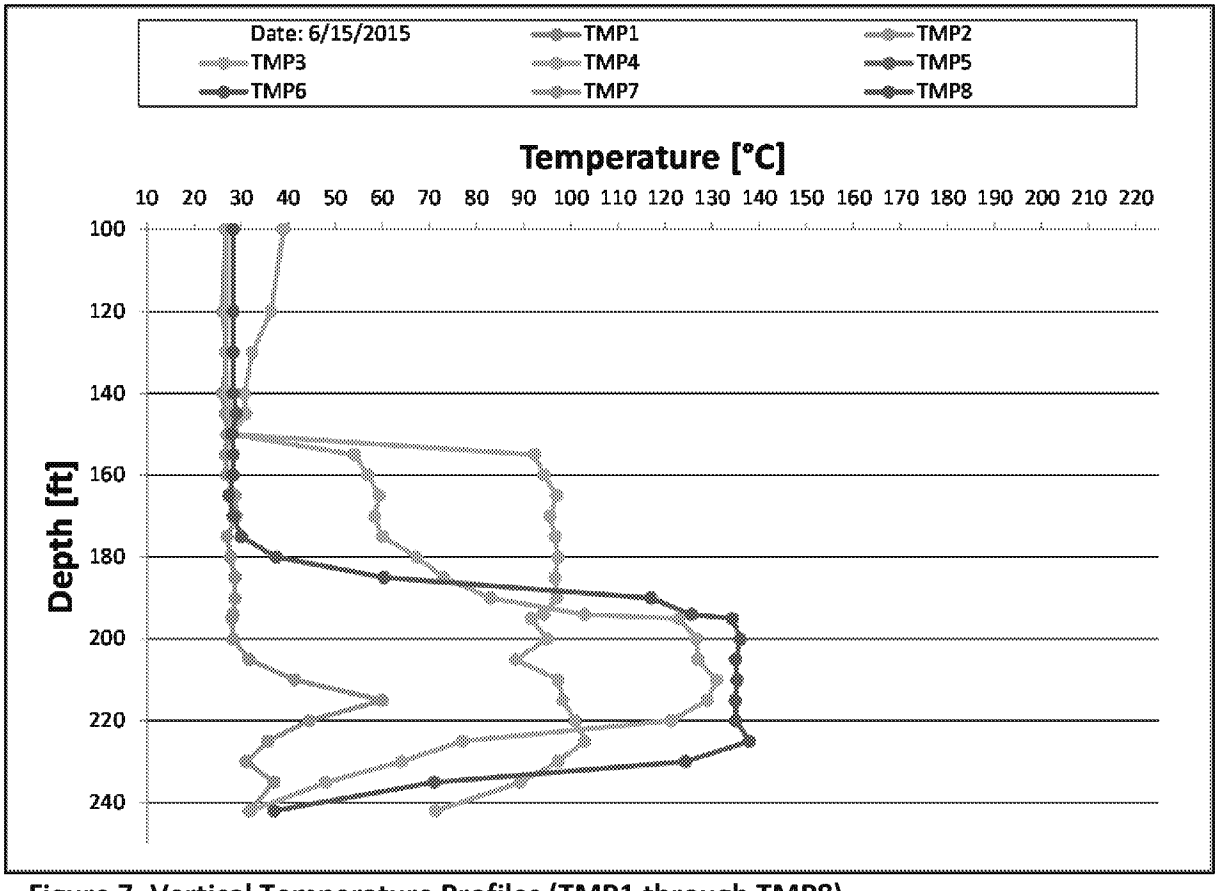

Figure 7. Vertical Temperature Profiles (TMP1 through TMP8)

Note: The replacement sensors installed in TMPs 06, 07 and 09 are not reading correctly and

therefore the temperatures have not been included on this figure. TerraTherm is in the process of troubleshooting the sensors.

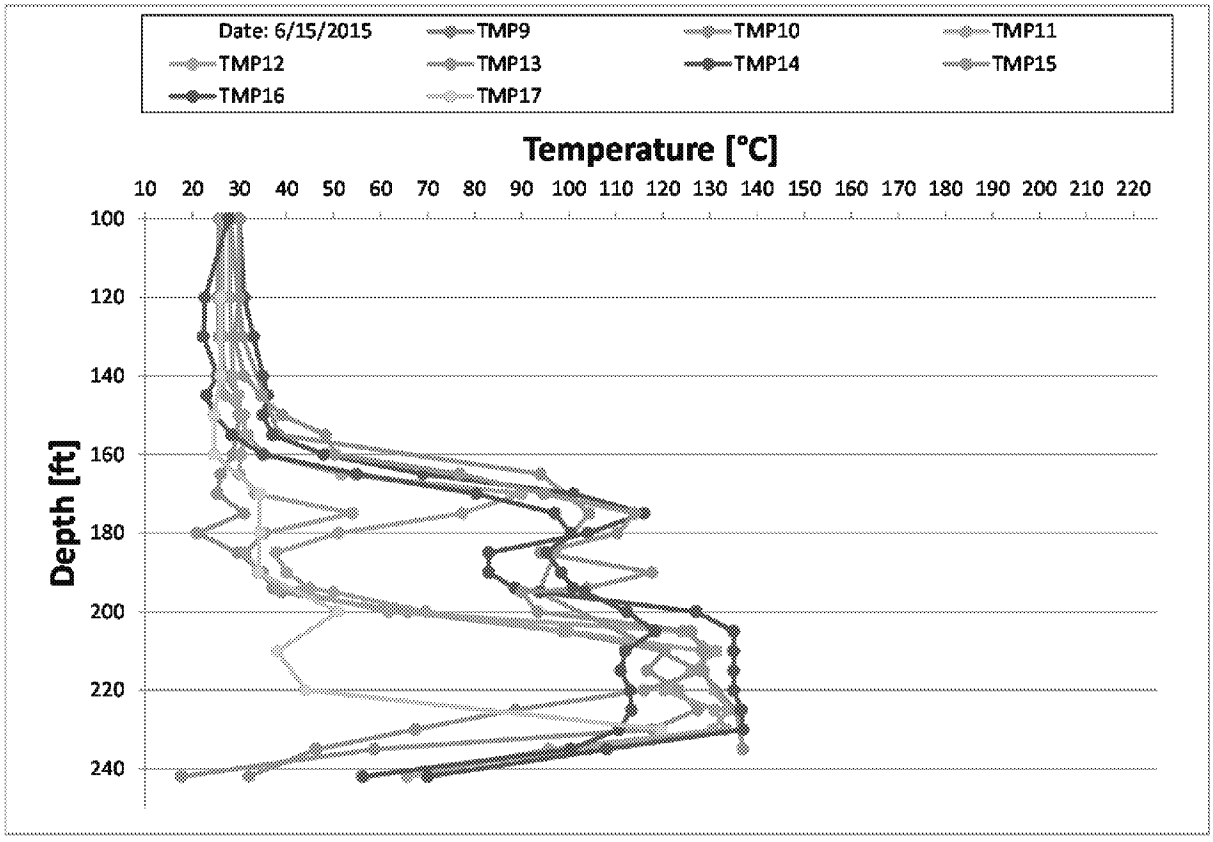

Figure 8. Vertical Temperature Profiles (TMP9 through TMP17)

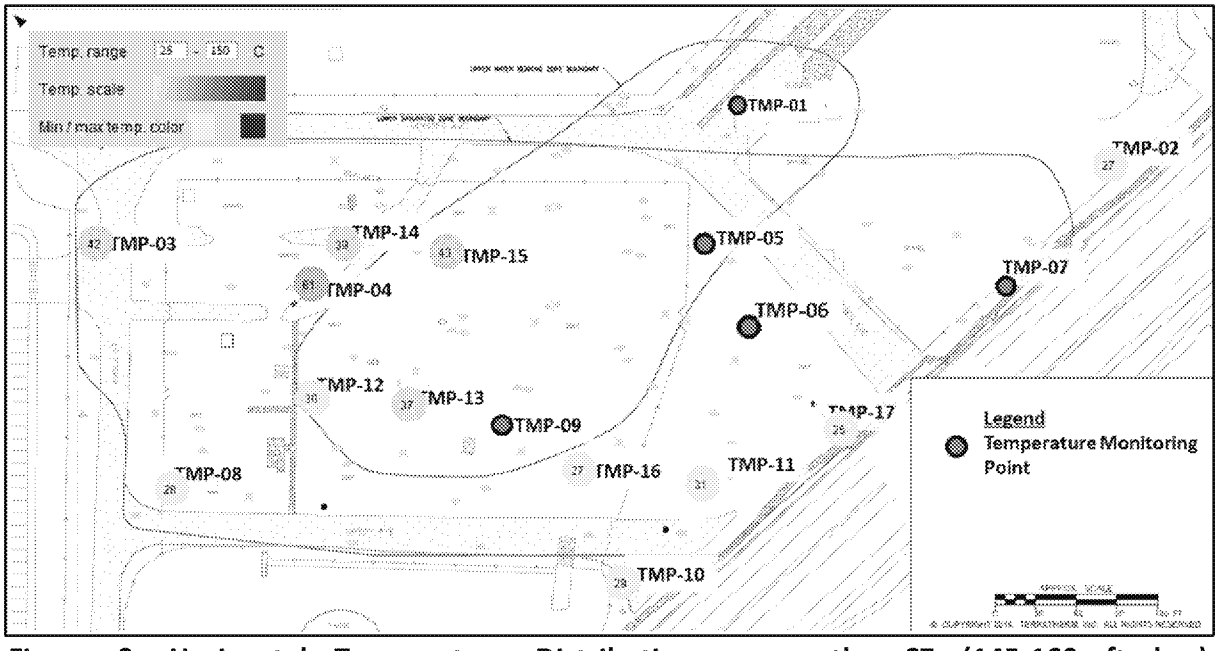

Figure 9. Horizontal Temperature Distribution across the CZ (145-160 ft bgs) (temperatures shown in °C)

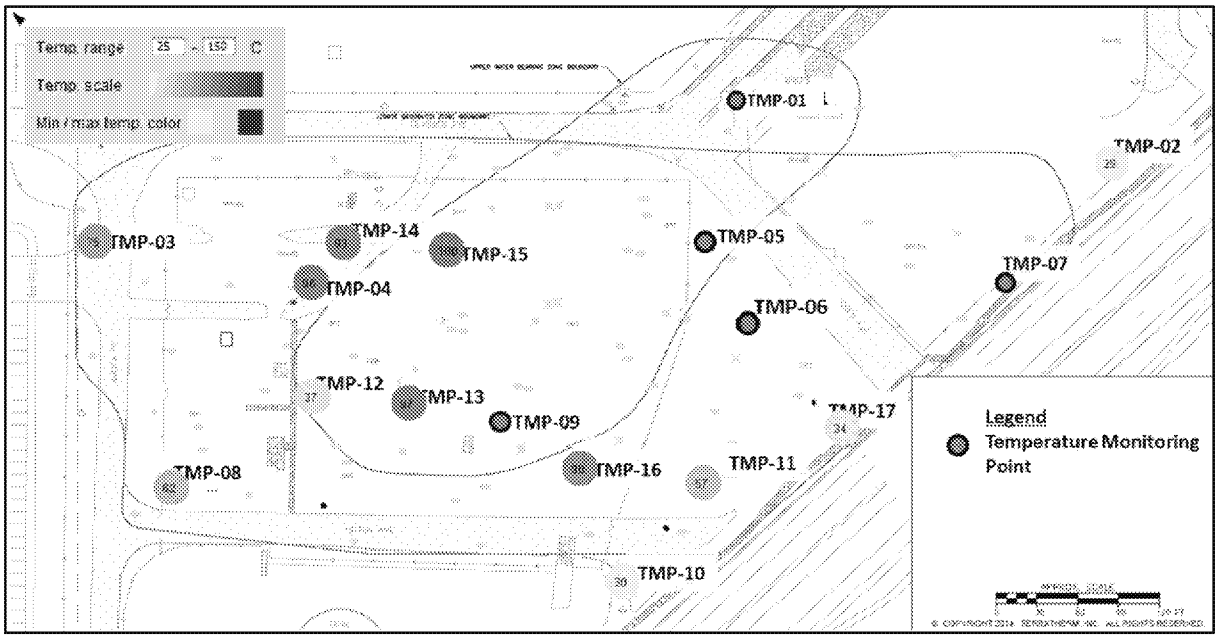

Figure 10. Horizontal Temperature Distribution across the UWBZ (161-195 ft bgs) (temperatures shown in °C)

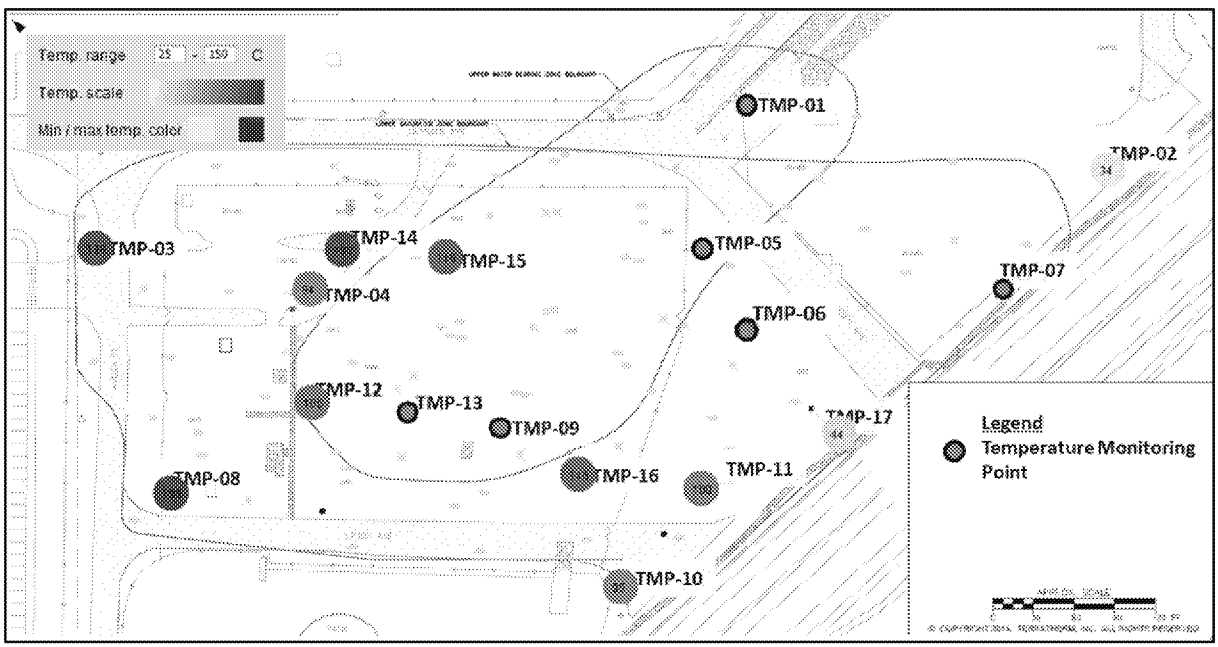

Figure 11. Horizontal Temperature Distribution across the Lower Permeable Zone (196-210 ft bgs) (temperatures shown in °C)

Note: The replacement sensor installed in TMP-13 within the LPZ zone is not reading correctly and therefore the temperature has not been included on this figure.

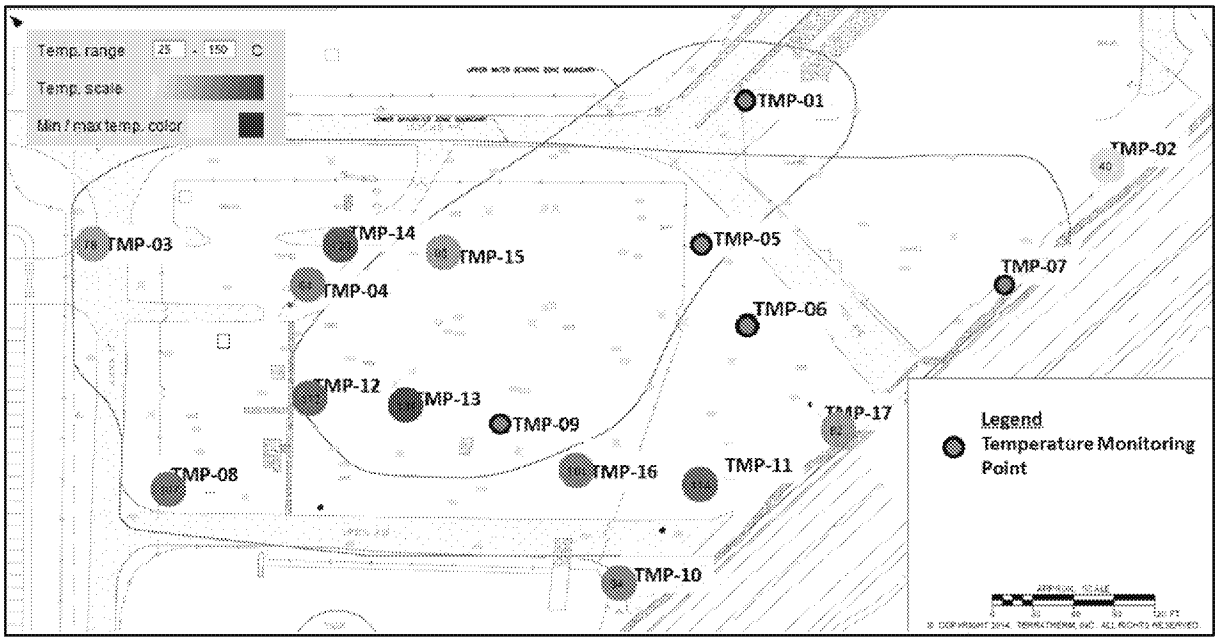

Figure 12. Horizontal Temperature Distribution across the LSZ (211-245 ft bgs) (temperatures shown in °C)

Figure 13 below shows the observed temperatures by depth at selected LSZ extraction wells.

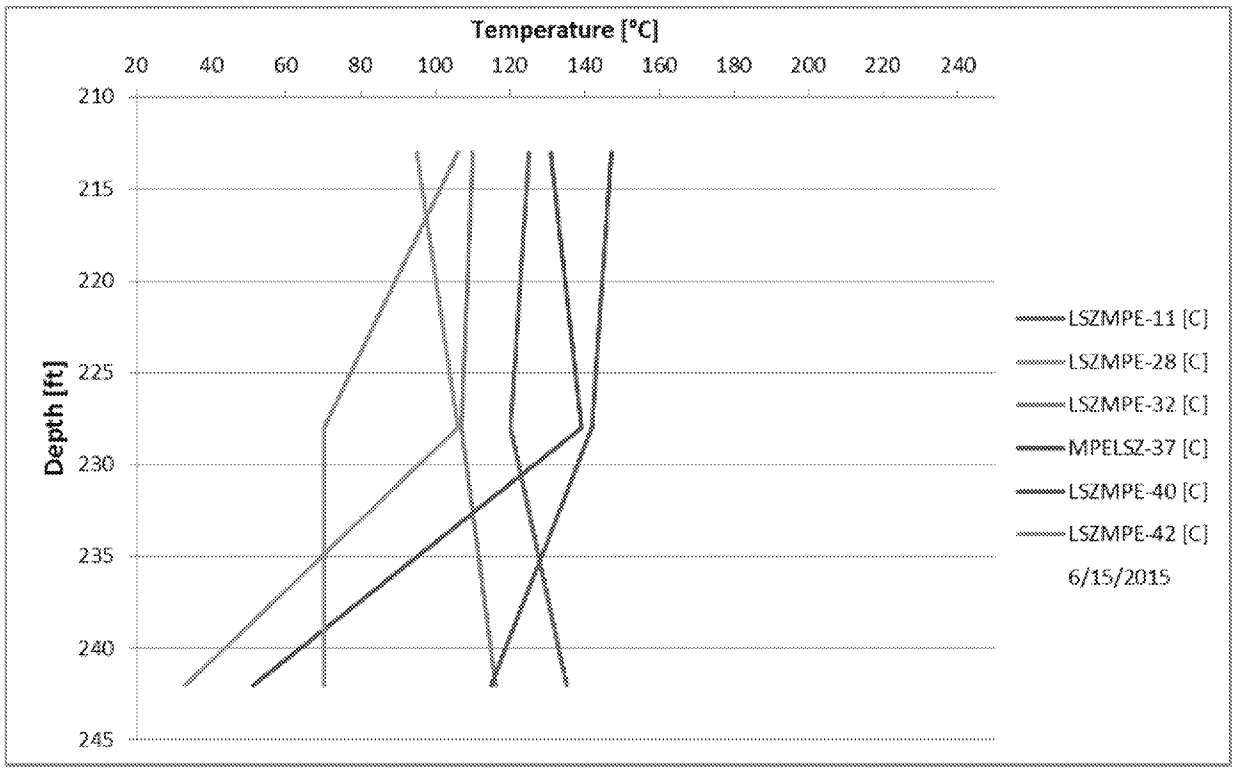

Figure 13. Temperatures by Depth at Selected LSZ Extraction Wells (211-245 ft bgs) (temperatures shown in °C)

9. Cumulative Steam Injection

Steam injection was initiated Thursday, October 16, 2014. Figure 14 below shows the cumulative steam injection for each of the three injection zones.

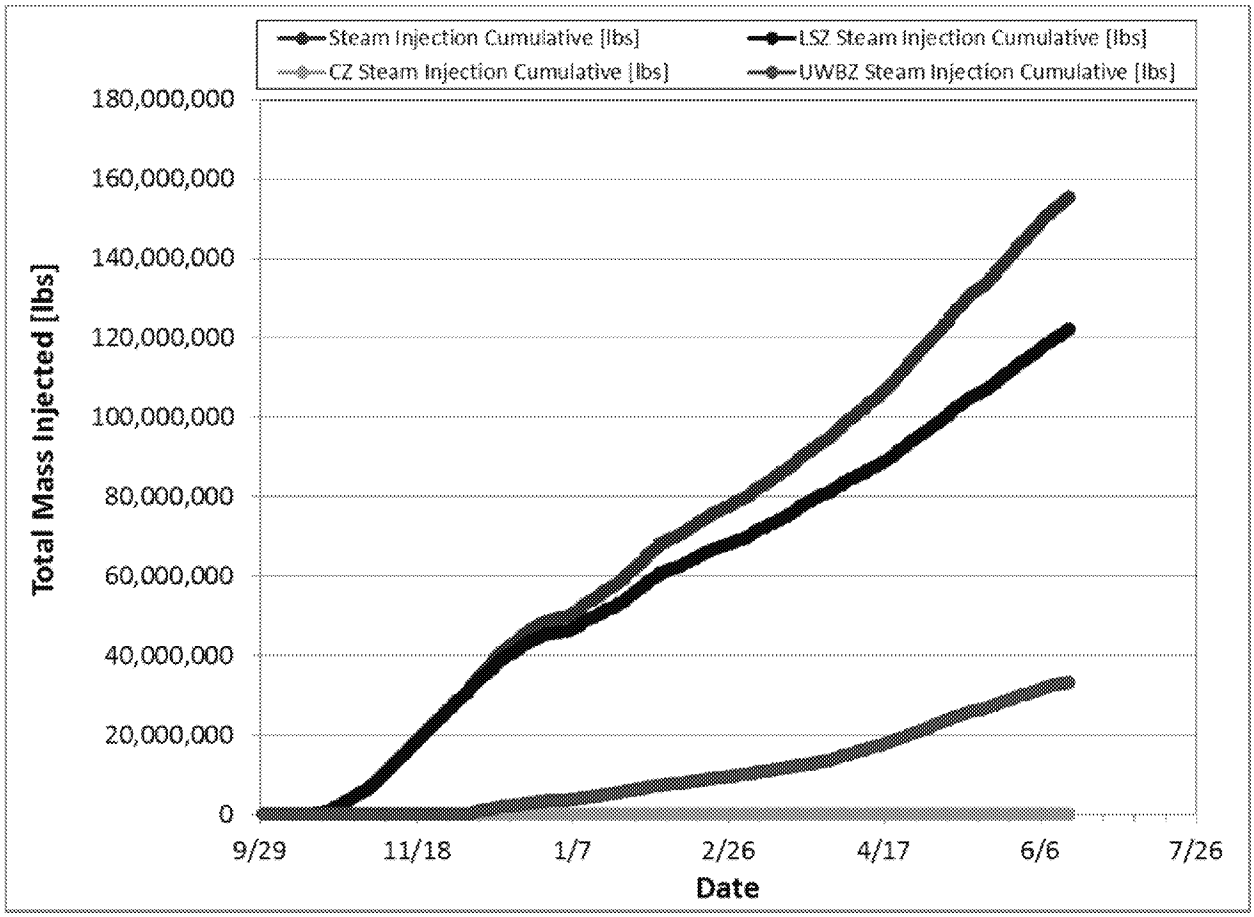

Figure 14. Cumulative Steam Injection for Each of the Three Injection Zones

Note: The steam injection has not yet been initiated in the CZ.

10. Steam Injection Rates

The figure below shows the steam injection rates for each of the three injection zones.

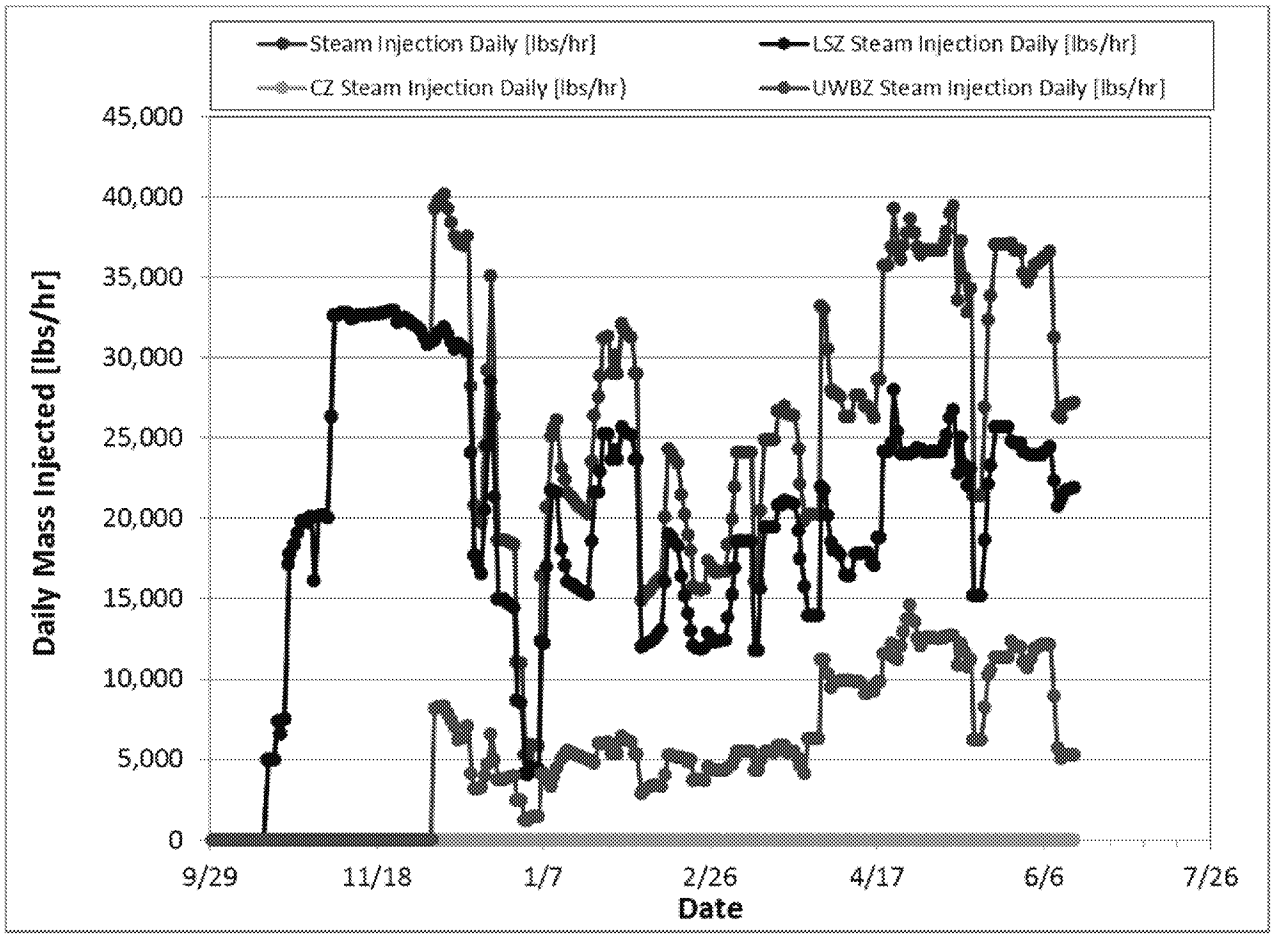

Figure 15. Steam Injection Rate for Each of the Three Injection Zones

Note: The steam injection has not yet been initiated in the CZ.

11. Cumulative Water Extraction by Zone

The cumulative water extraction for each of the three treatment zones is shown below. The cumulative water extraction is calculated based on flow meters installed at each of the 57 extraction wells (accuracy should be considered +/- 20%). The figure below shows the net liquid extracted from the subsurface at the site and does not include the fraction of water that is recirculated to the eductor wells and used as motive water.

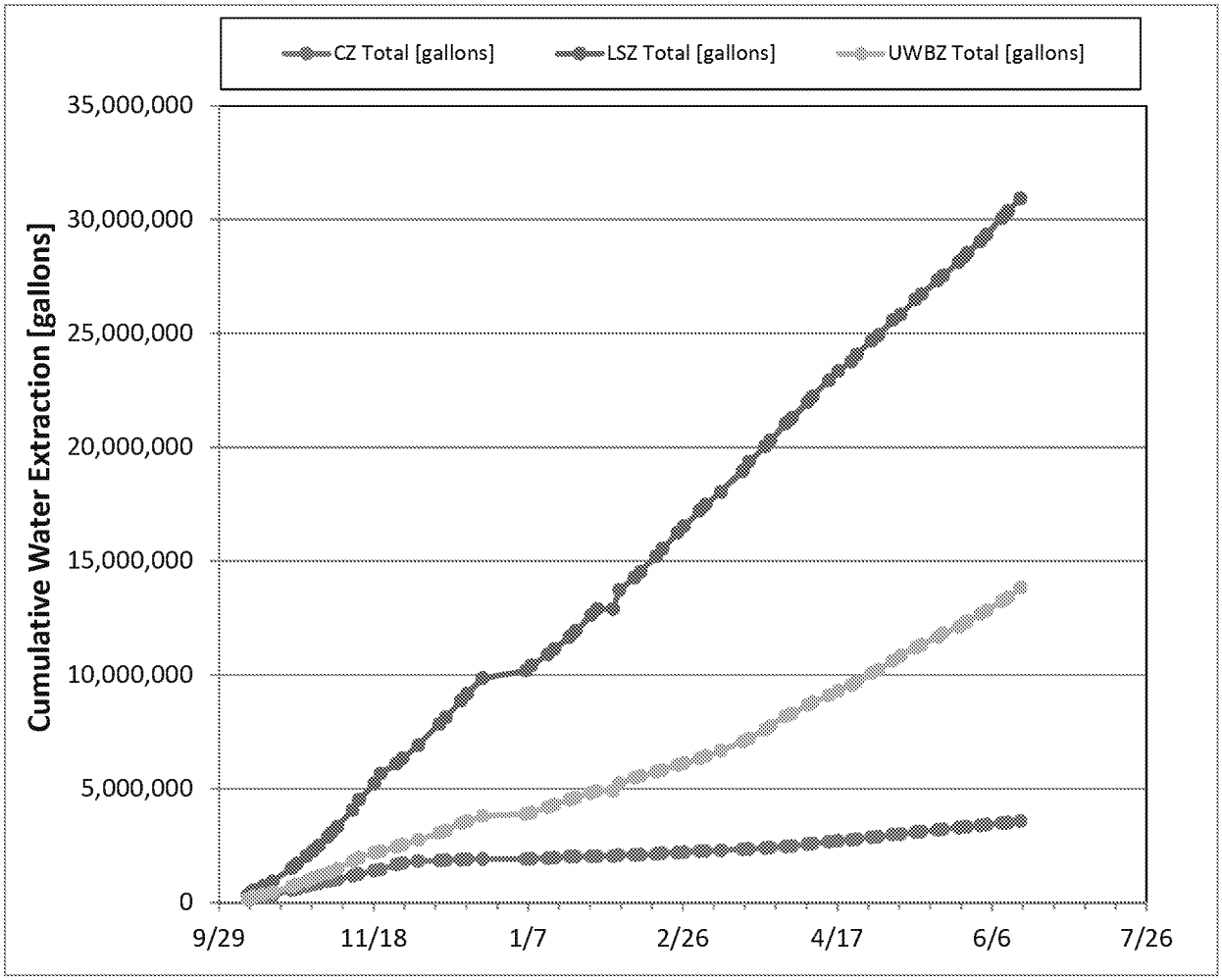

Figure 16. Cumulative Water Extraction for Each of the Three Treatment Zones

12. Water Extraction Rates by Zone

The figure below shows the water extraction rates for each of the three treatment zones.

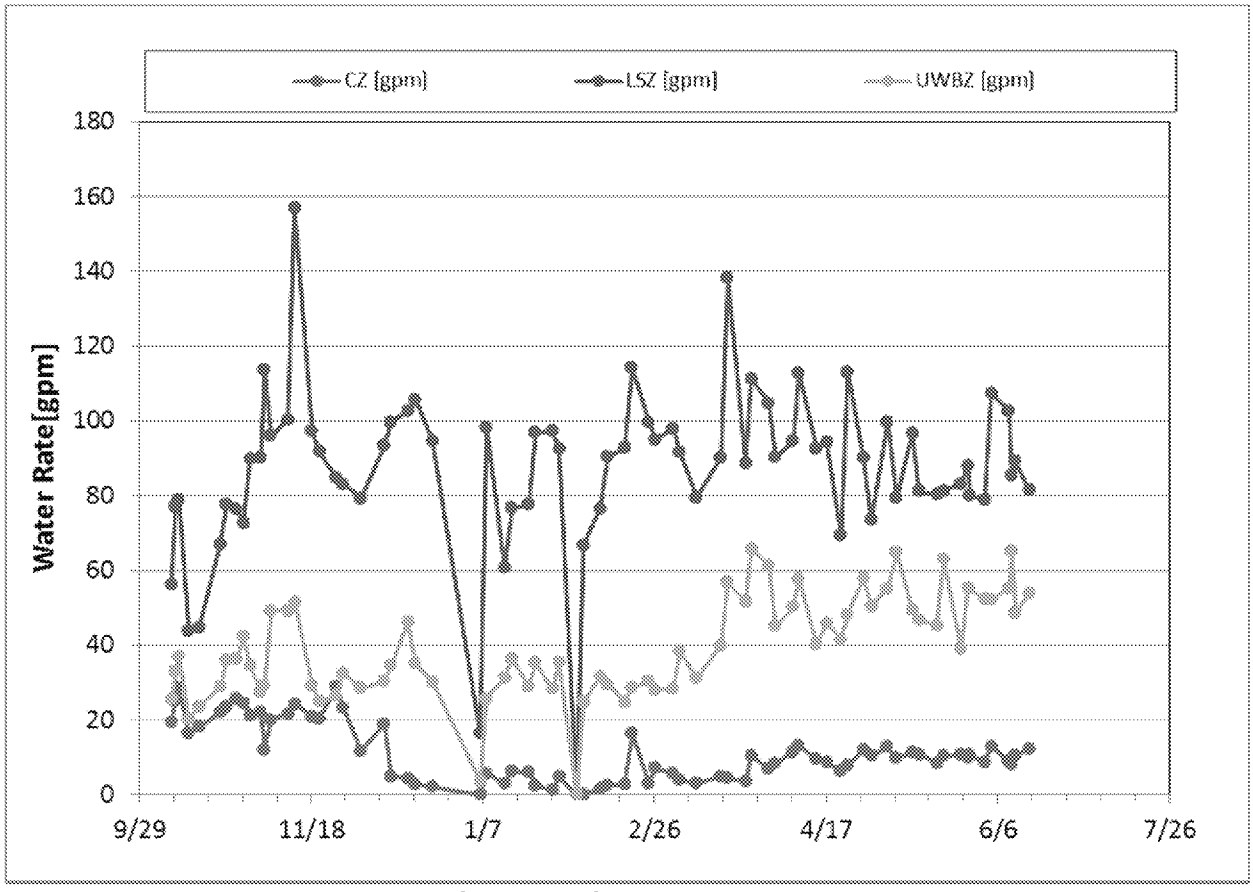

Figure 17. Water Extraction Rates for Each of the Three Treatment Zones

13. Cumulative Water Balance

The cumulative water balance for the site is shown below. The chart shows the net liquid extracted from the subsurface at the site and does not include the fraction of water that is recirculated to the eductor wells and used as motive water.

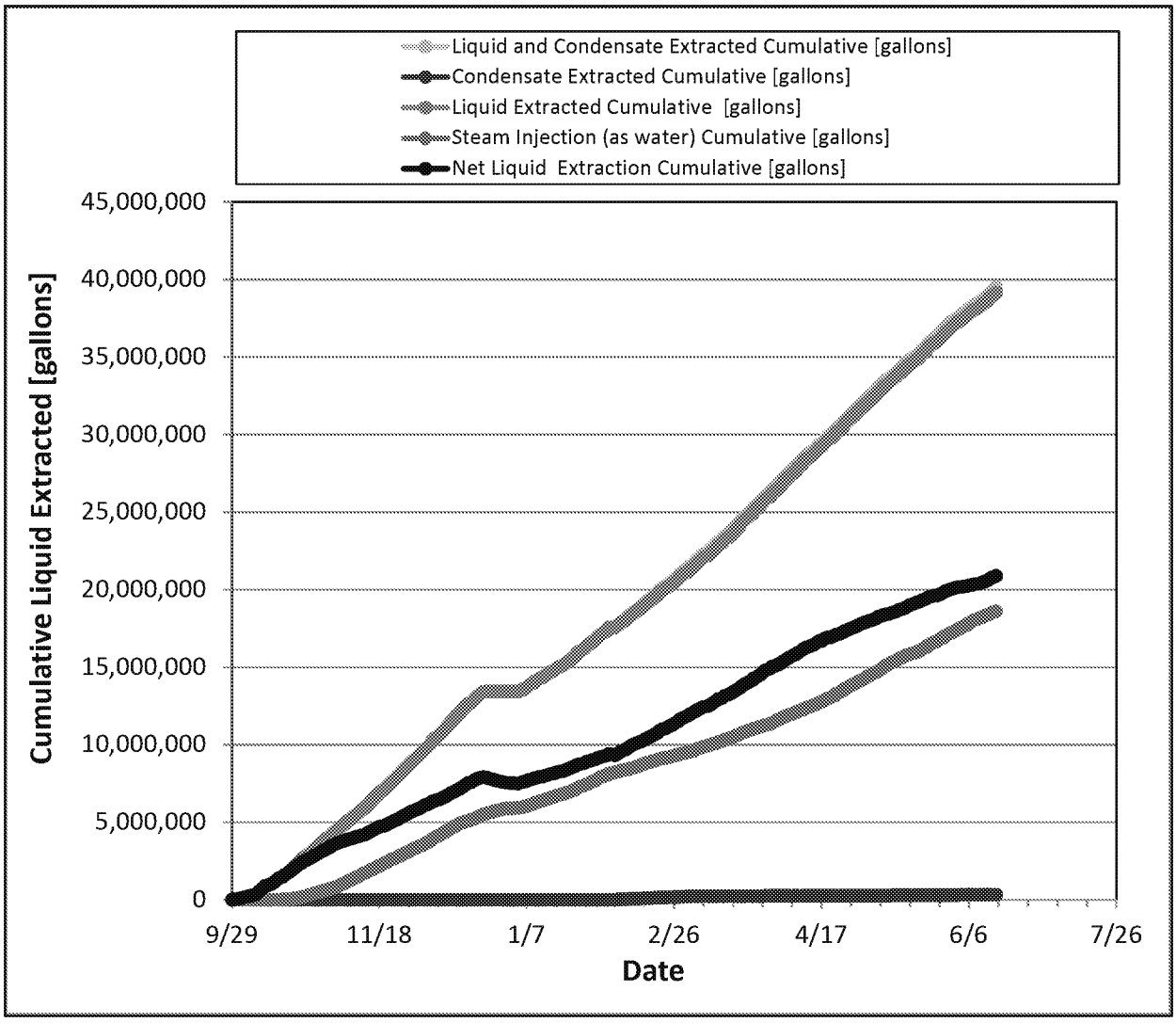

Figure 18. Cumulative Water Balance

14. Water Balance Rate

The total system water extraction rates are shown in the figure below.

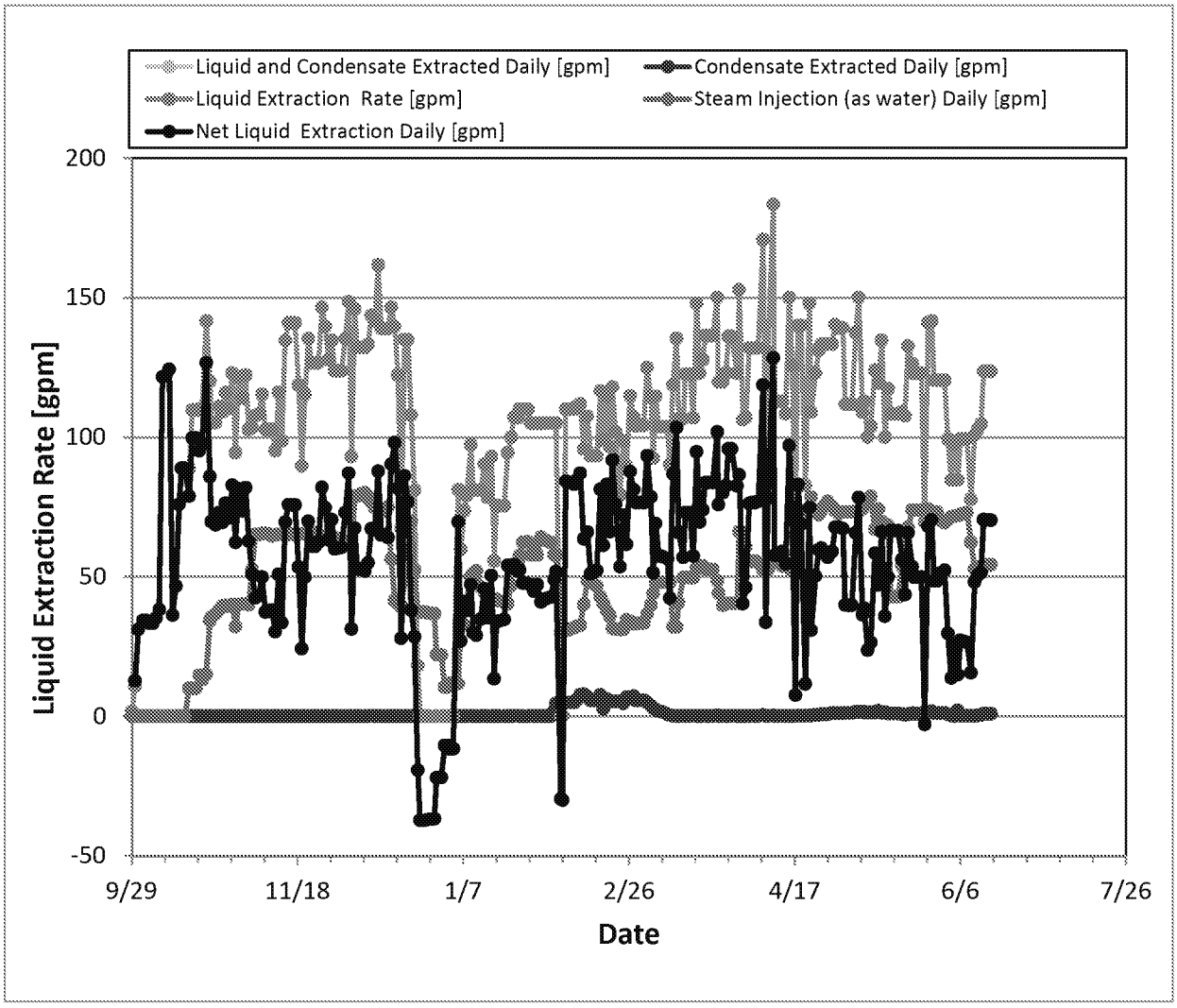

Figure 19. Water Balance Rates

15. Cumulative Energy Balance

The cumulative energy balance for the site is shown below. As shown below, the temperature of the extracted wellfield water (combined motive and formation water) is increasing and energy is starting to be extracted from the subsurface.

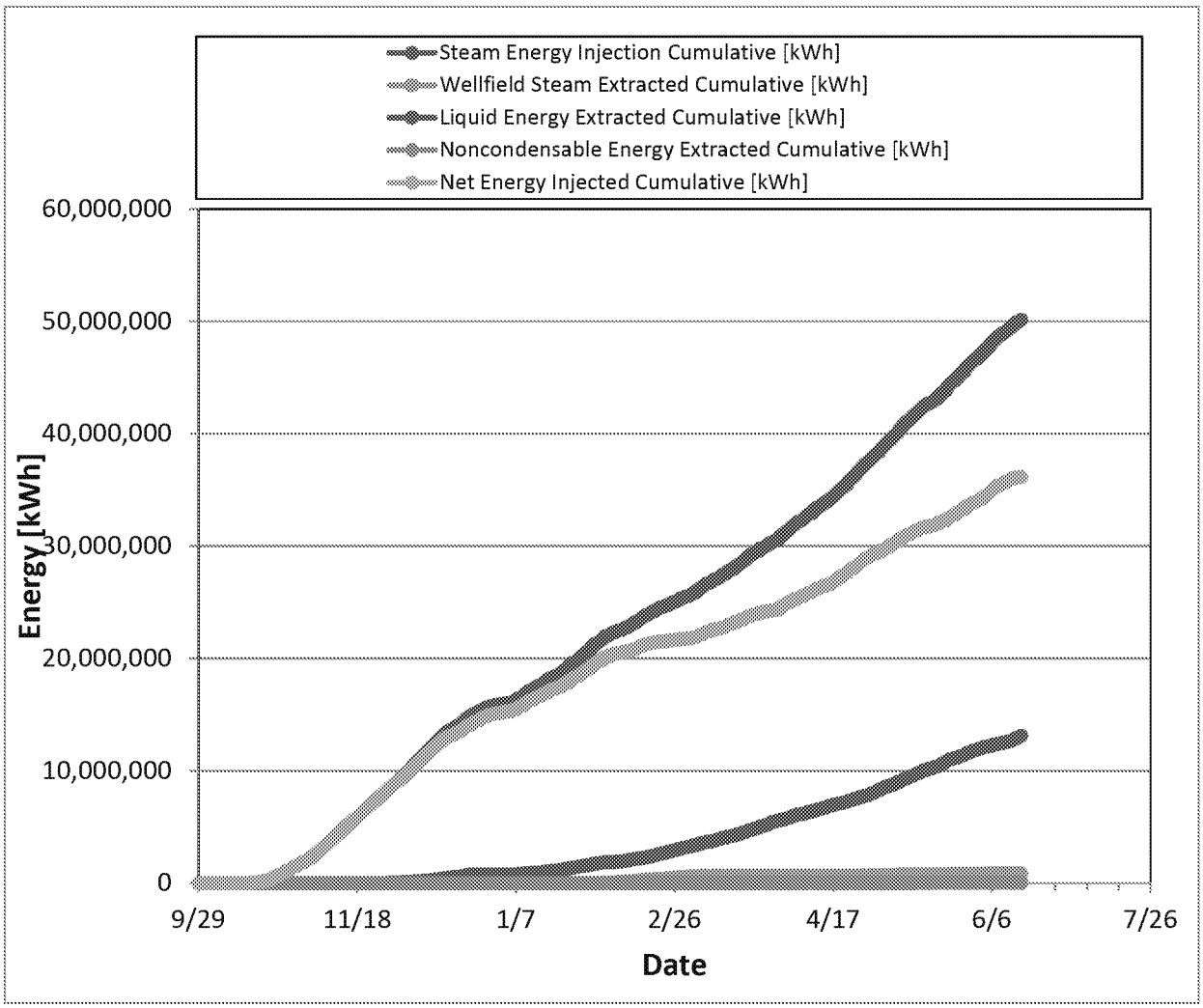

Figure 20. Cumulative Energy Balance

16. Energy Balance Rates

The energy balance rates are shown below.

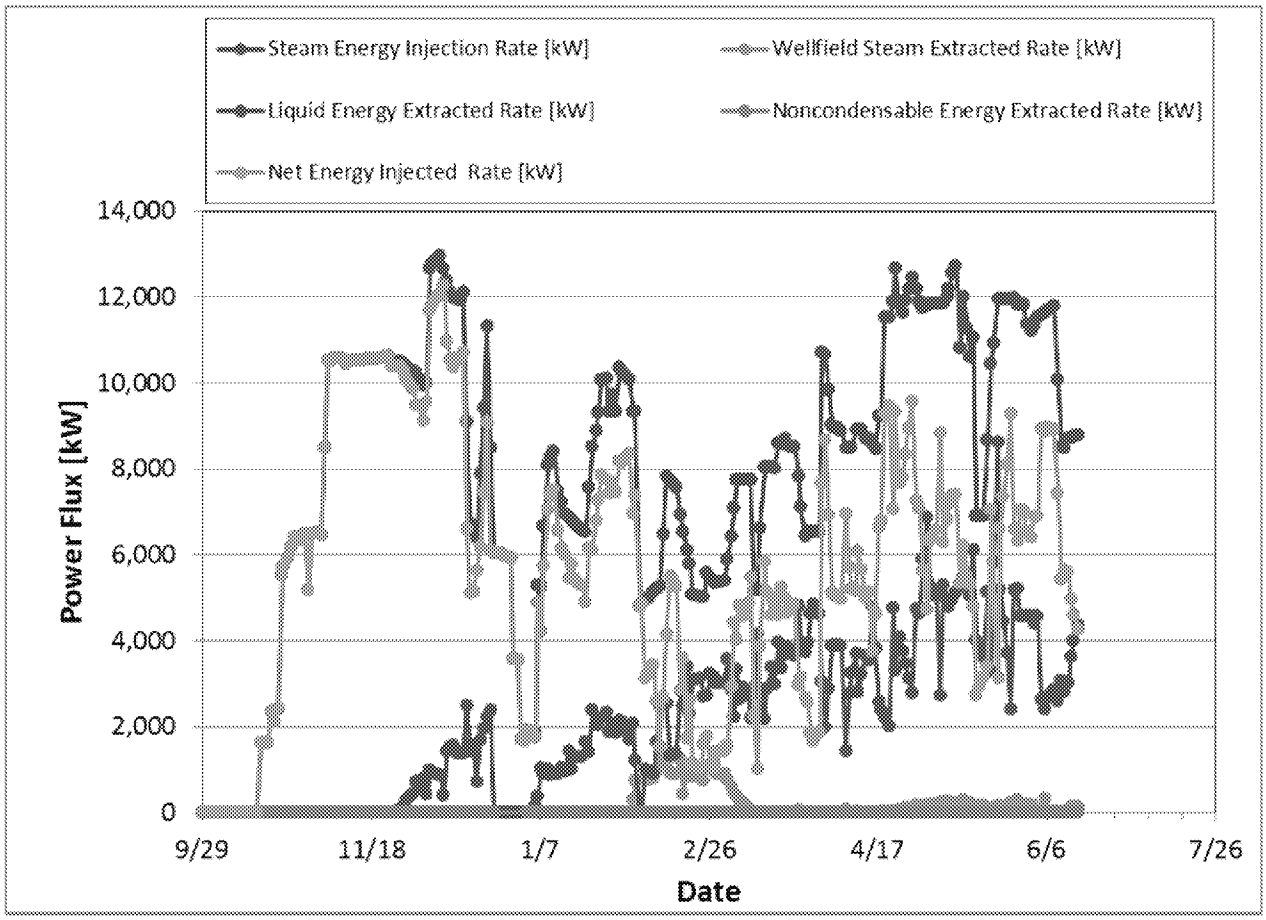

Figure 21. Energy Balance Rates

Note: At this time only limited energy has been extracted as steam from the site based on the condensate generated. Based on energy balance analysis, additional steam is likely being pulled into and condensing in the liquid extraction system.

17. Perimeter Water Level Data

Table 2 below presents the change in perimeter groundwater elevations since SEE system startup. The readings collected on September 24, 2014 (not shown) represent baseline conditions. A negative number shows that the groundwater elevation is lower than the baseline elevation, thus indicating an inward hydraulic gradient into the treatment zone. Liquid extraction began on September 29, 2014. Perimeter water level data are collected on a weekly basis. The regional groundwater table at the Site is increasing at a rate of approximately 1.5 ft/year; thus, each measured value shown in Table 2 has been corrected to take the regional changes into account.

Table 2. Perimeter Groundwater Elevation Changes

	5/29/2015		6/5/2015		6/9/2015		6/12/2015	
Monitoring Well	Change from Baseline	Change from Previous	Change from Baseline	Change from Previous	Change from Baseline	Change from Previous	Change from Baseline	Change from Previous
CZ/UWBZ Wells								
ST012-C01	-0.31	0.05	-0.36	-0.02	-0.35	0.03	-0.35	0.01
ST012-C02	-0.35	0.14	-0.40	-0.03	-0.34	0.08	-0.42	-0.07
UWBZ Wells								
ST012-RB-3A	-0.11	0.87	-0.05	0.08	-0.33	-0.26	-1.26	-0.92
ST012-U02	0.39	0.59	0.25	-0.12	0.07	-0.16	-0.40	-0.46
ST012-U11	-0.13	0.98	0.15	0.30	0.07	-0.06	-0.46	-0.52
ST012-U12	0.15	1.26	0.27	0.14	0.08	-0.17	-0.58	-0.65
ST012-U37	-0.01	0.98	0.09	0.12	-0.40	-0.47	-1.47	-1.06
ST012-U38	-0.16	0.46	-0.08	0.10	-0.15	-0.05	-0.49	-0.33
LSZ Wells								
ST012-W11	-0.70	0.52	0.30	0.05	-0.64	-0.04	-1.19	-0.53
ST012-W12	-0.36	0.48	-0.36	0.02	-0.66	-0.28	-0.76	-0.09
ST012-W24	-0.73	0.05	-0.48	0.27	-1.12	-0.62	-1.20	-0.07
ST012-W30	0.80	0.97	2.15	1.37	-0.59	-2.72	-0.33	0.27
ST012-W34	-0.05	0.48	-0.11	-0.04	-0.82	-0.69	-0.87	-0.04
ST012-W36	0.86	0.61	0.75	-0.09	-0.24	-0.97	-0.44	-0.19
ST012-W37	-0.72	0.39	-0.74	0.01	-1.09	-0.33	-0.88	0.22
ST012-W38	-0.11	0.50	-0.15	-0.02	-0.69	-0.52	-0.80	-0.10

Figure 22 shows the manually collected groundwater elevation trends since system startup. Additionally Figure 23 shows the groundwater elevations continuously logged in selected perimeter wells equipped with transducers. The regional groundwater table correction has also been applied to Figure 22 below.

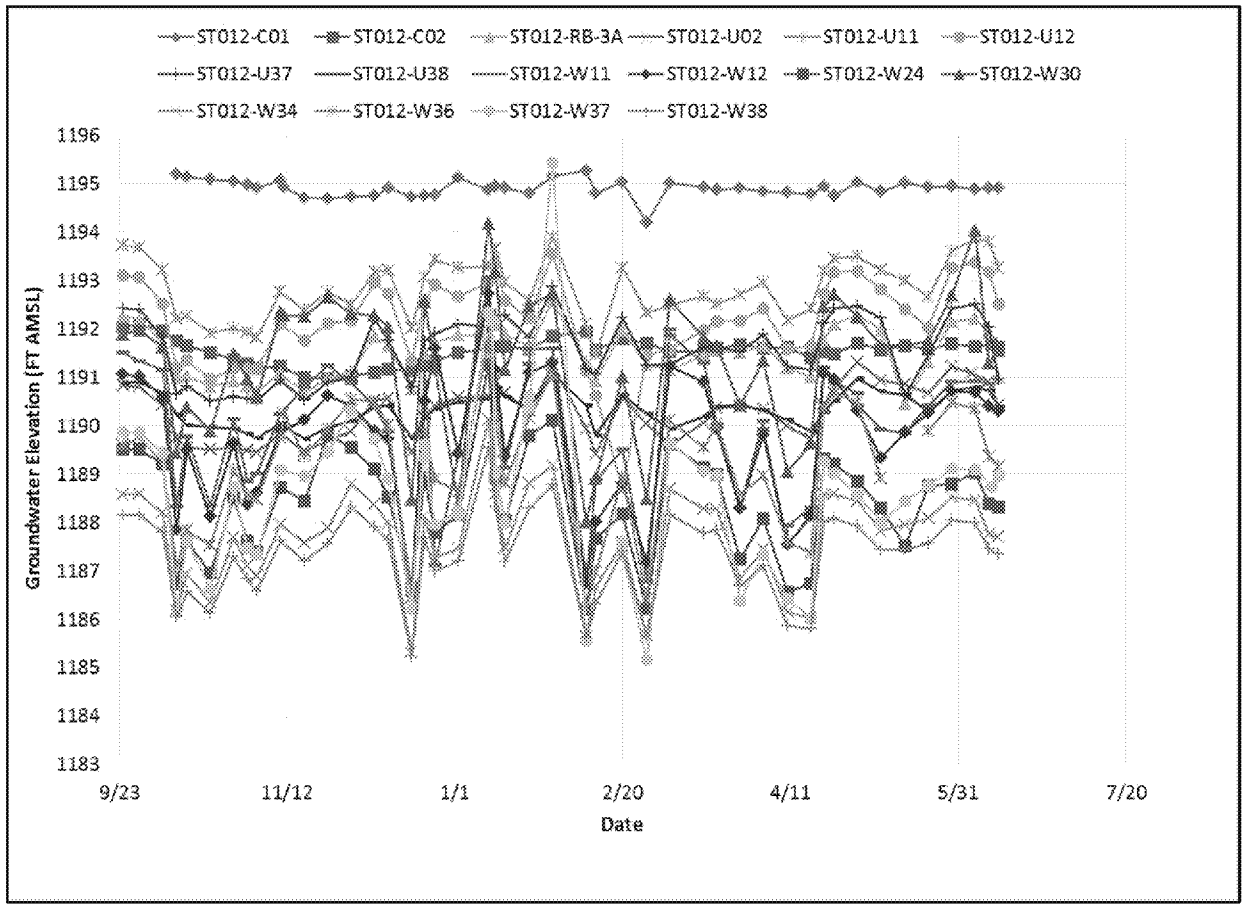

Figure 22. Manually Collected Perimeter Groundwater Elevations

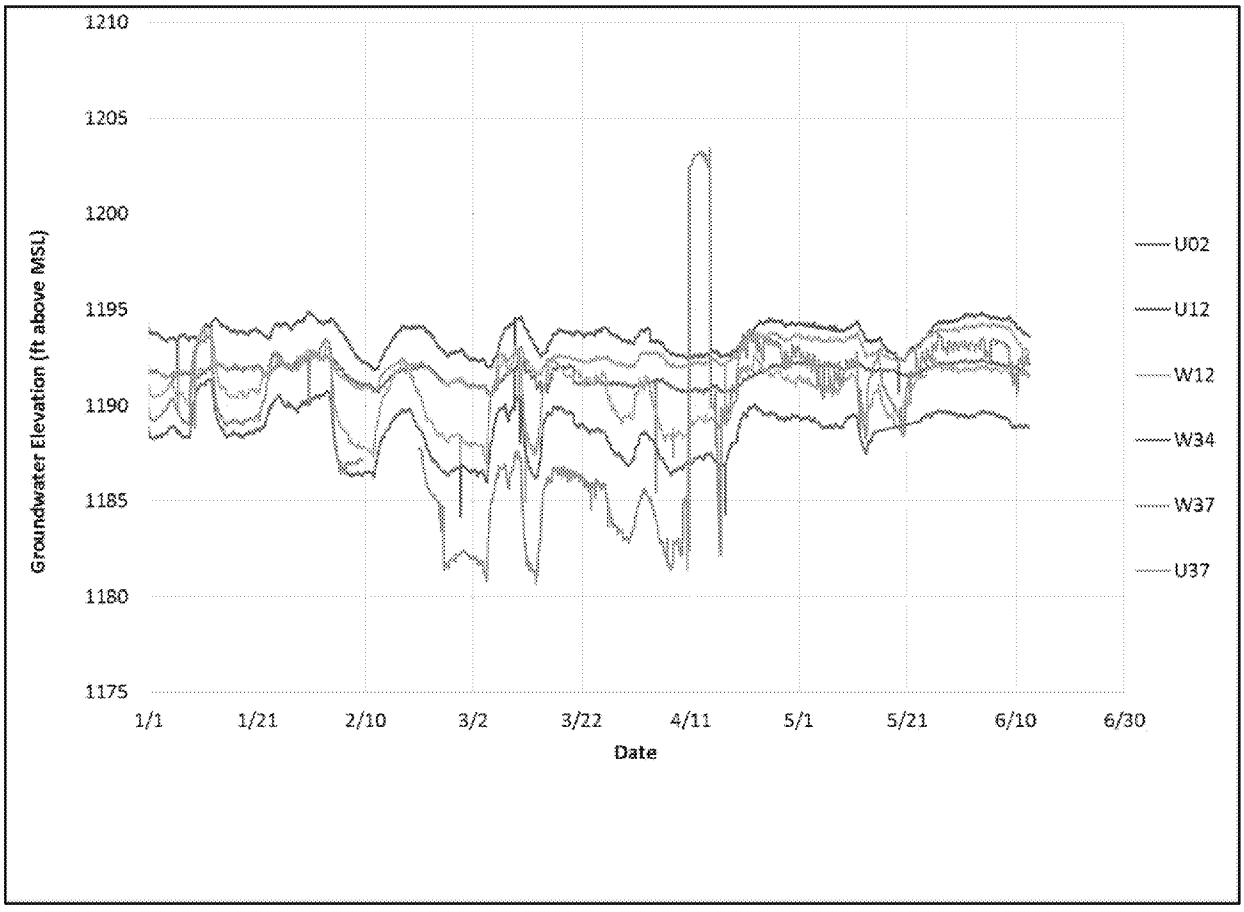

Figure 23. Automatically Collected Perimeter Groundwater Elevations

Table 3 below presents the measured LNAPL thicknesses of the perimeter wells at the site. The readings collected on September 24, 2014 represent baseline conditions while the readings collected after are during SEE operations. Perimeter LNAPL thickness data are collected on a weekly basis.

Table 3. Perimeter LNAPL Thicknesses (ft)

Monitoring Well	6/5/2015		6/9/2015-6/10/15		6/12/2015	
CZ/UWBZ Wells	Before bailing	After Bailing	Before bailing	After Bailing	Before bailing	After Bailing
ST012-C01	0.00	0.00	0.00	0.00	0.00	0.00
ST012-C02	0.00	0.00	0.00	0.00	0.00	0.00
UWBZ Wells						
ST012-U02	0.00	0.00	0.00	0.00	0.00	0.00
ST012-U11	0.00	0.00	0.00	0.00	0.00	0.00
ST012-U12	0.00	0.00	0.00	0.00	0.00	0.00
ST012-U37	0.00	0.00	0.00	0.00	0.00	0.00
ST012-U38	0.00	0.00	0.00	0.00	0.00	0.00
ST012-RB-3A	0.00	0.00	0.00	0.00	0.00	0.00
LSZ Wells						
ST012-W11	45.06	0.00	35.75	5.02	34.58	0.10
ST012-W12	0.00	0.00	0.00	0.00	0.00	0.00
ST012-W24	0.00	0.00	0.00	0.00	0.00	0.00
ST012-W30	0.00	0.00	10.67	0.42	8.49	0.28
ST012-W34	0.00	0.00	0.00	0.00	0.00	0.00
ST012-W36	0.00	0.00	0.00	0.00	0.00	0.00
ST012-W37	51.00	6.52	43.29	1.35	41.71	0.16
ST012-W38	0.00	0.00	0.00	0.00	0.00	0.00

On December 1, 2014, temperatures at selected perimeter wells were added to the monitoring program. Figure 24 below shows the manually collected temperatures recorded at the wells included in the monitoring program. Additionally Figure 25 shows the temperatures continuously logged in selected perimeter wells equipped with transducers.

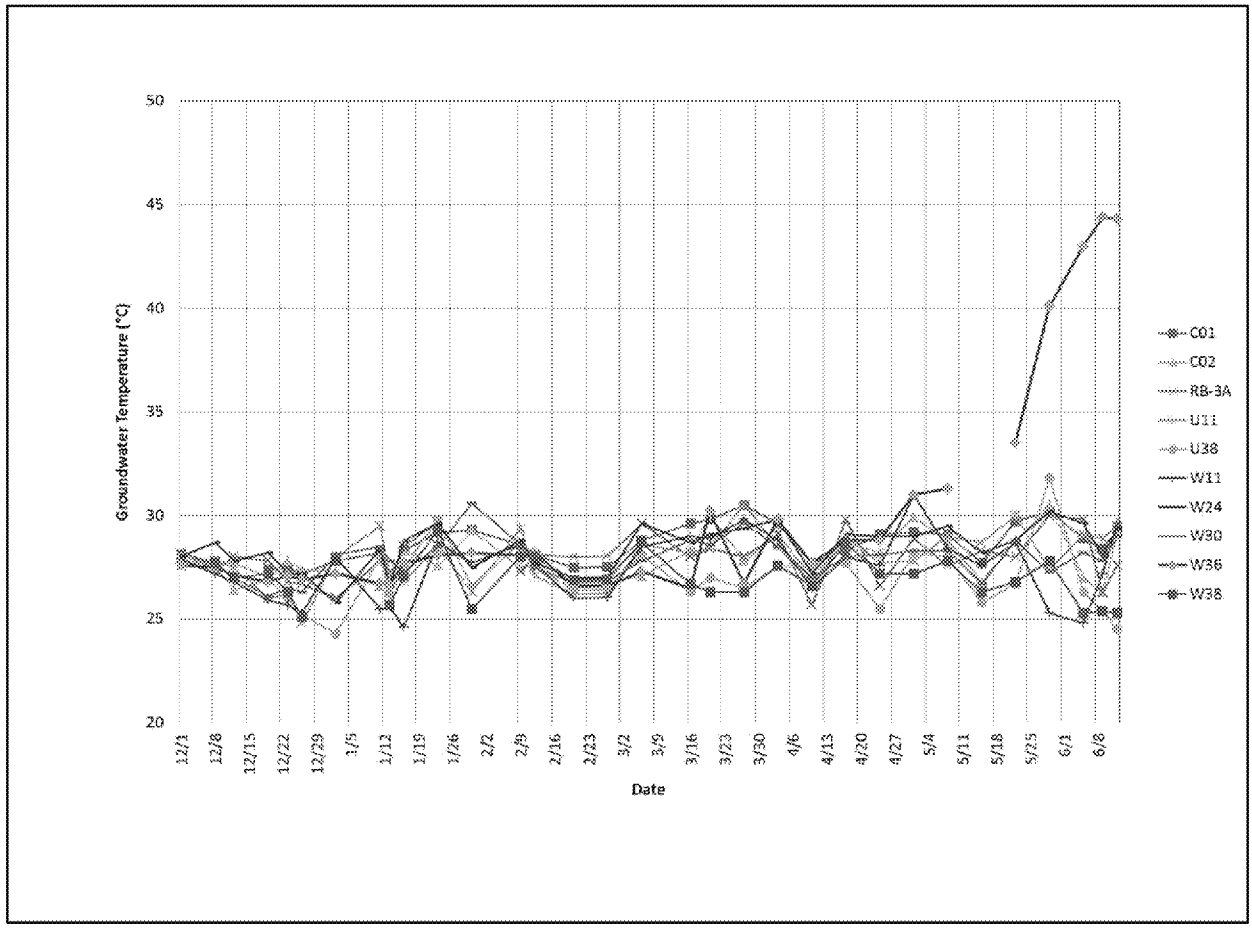

Figure 24. Manually Collected Perimeter Well Groundwater Temperatures

Note: Thermocouples are measured at approximate depths as follows (in feet below top of casing): C01=162; C02=168; RB-3A=161; U11=128; U38=164; W24=161; W30=134; W36=165; and W38=164. W11 will be measured during the week of June 15, 2015. U11 and W30 will be extended.

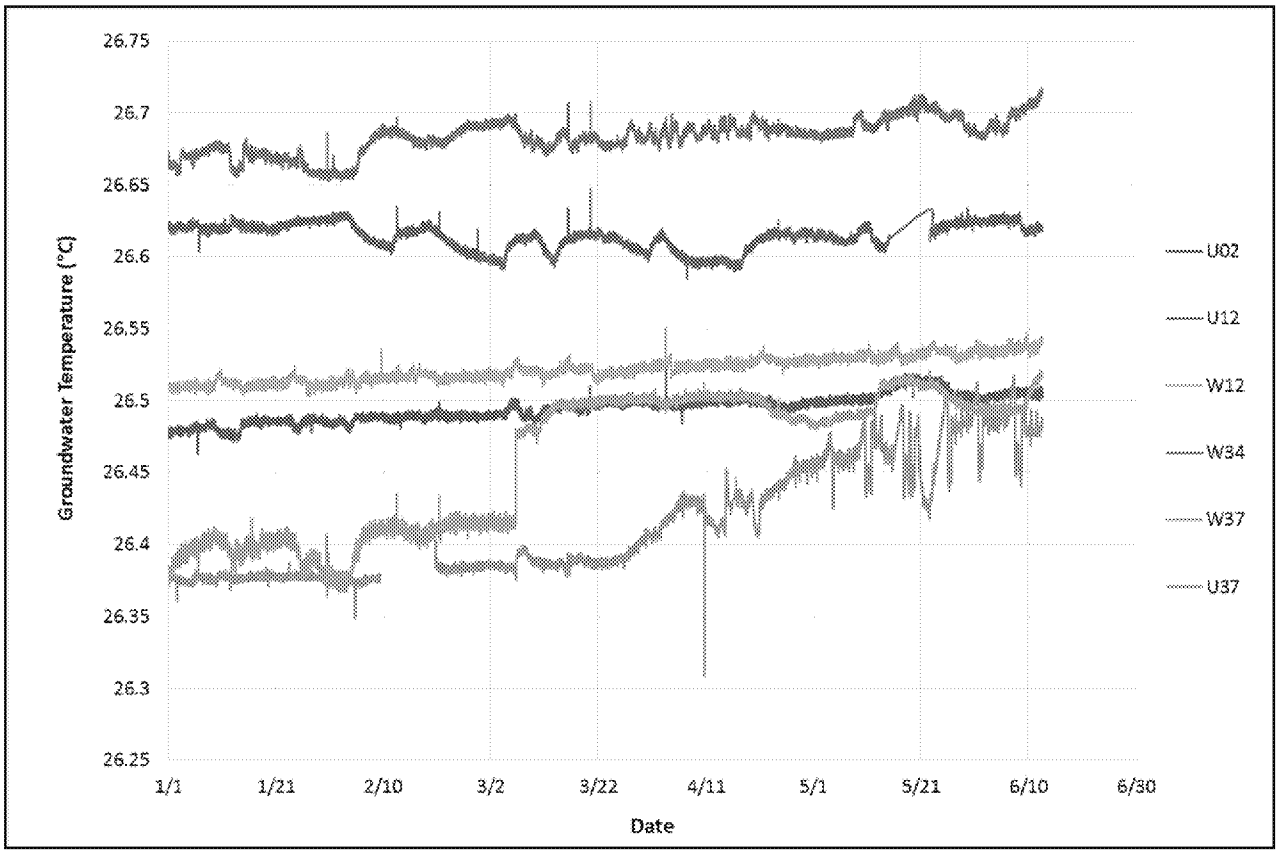

Figure 25. Automatically Collected Perimeter Well Groundwater Temperatures

Notes:
On March 7, 2015 operational personnel replaced the U37 logger unit. The increase in temperature on March 7, 2015 at U37 is a result of this replacement.

Transducers are measured at depths as follows (in feet below top of casing): U02= 185.03; U12= 185.71; U37= 182.30; W12= 238.16; W34= 235.91; and W37= 226.18

18. Natural Gas Usage

The following figure shows the natural gas usage rate in cubic feet per hour (cf/hr) and cumulative natural gas use in cubic feet (cf) to date at the site.

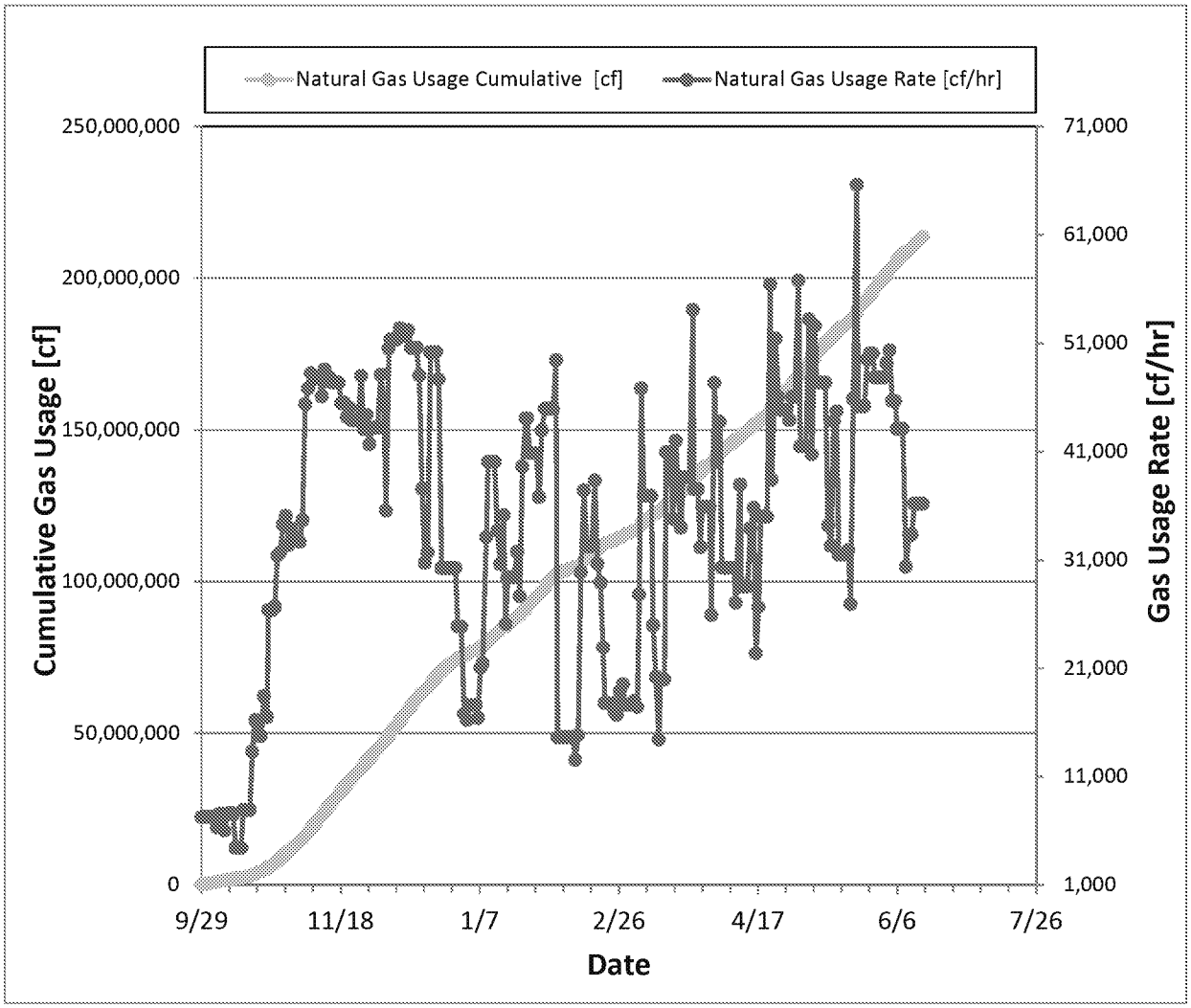

Figure 26. Natural Gas Usage

19. Waste Generation

On January 19, 2015 a total of 8,033 gallons of material from tank cleanout activities was removed from the site by Mesa Oil for recycling. The mass of JP-4 in the material was estimated to be 2,857 gallons or 18,800 lbs.

On February 18 and 19, 2015 a total of 24,430 gallons of material from tank cleanout activities was removed from the site by Mesa Oil for recycling. The mass of JP-4 in the material was estimated to be 3,645 gallons or 23,984 lbs.

On March 12, 2015 a total of 11,359 gallons of predominantly water from tank cleanout activities was removed from the site by Mesa Oil for recycling. The JP-4 mass in the water was limited.

On March 20, 2015 the first shipment of bag filters (four cubic yard boxes) from the SEE process treatment system was shipped offsite for non-hazardous disposal.

On March 30 and 31, 2015 a total of 32,000 lbs of spent liquid carbon was removed from the site by Evoqua Water Technologies for regeneration at their Red Bluff, CA facility.

On April 24, 2015 a shipment of bag filters (three cubic yard boxes) from the SEE process treatment system was shipped offsite for non-hazardous disposal.

On May 29, 2015 a shipment of bag filters (four cubic yard boxes) from the SEE process treatment system was shipped offsite for non-hazardous disposal.

On June 11, 2015 three 55-gallon drums of soil dug from around the Hypro NAPL filter were shipped offsite for non-hazardous disposal.

On June 10, 2015 a total of 5,727 gallons of oily bio-impacted water from tank cleanout activities was removed from the site by Mesa Oil for recycling.

20. NAPL Reuse

On April 7, 2015 a total of 12,647 gallons of stored NAPL was sent to Mesa Oil for reuse. The analysis showed that 703 gallons of the total fluid was water. The water has been subtracted from the NAPL recovery estimate.

On April 21-22, 2015 a total of 13,076 gallons of stored NAPL was sent to Mesa Oil for reuse. Analysis showed a water content between <1% to 3% or a total of 227 gallons of water. The water removed has been subtracted from the NAPL recovery estimate.

On May 7, 2015 a total of 5,722 gallons of stored NAPL was sent to Mesa Oil for reuse.

On May 21, 2015 a total of 1,400 gallons of stored NAPL was sent to Mesa Oil for reuse.

21. Estimated Formation Water temperature

The calculated formation water temperatures are indicated in Table 4 below. The formation water temperatures have been calculated for each MPE well by measuring the eductor liquid feed and return flow rate together with the eductor liquid feed and return temperatures. The enthalpy increase in the liquid return temperature as compared to the liquid feed stream temperature is used to provide the MPE well specific formation temperature. Calculated formation water temperatures above the boiling point likely indicate that steam is being pulled into the liquid extraction system. These calculated data for each MPE well location are used in conjunction with the extracted vapor data collected at the MPE wells to make determinations on steam breakthrough around the site. All of these data are reviewed holistically (with other site data such as the TMP data) to determine when and where steam cycling events should commence.

Table 4. Calculated Well Formation Temperatures

Well	Formation Temperatures						
	5/29/2015	6/2/2015	6/4/2015	6/9/2015	6/10/2015	6/11/2015	6/15/2015
	Temperature [°F]	Temperature [°F]	Temperature [°F]	Temperature [°F]	Temperature [°F]	Temperature [°F]	Temperature [°F]
CZ11						123	133
CZ12	106	103	96	81	98	116	79
CZ14		137	111	117	100	130	102
CZ15							
CZ16		169	144	126	148	143	133
CZ17						91	
LSZ01	129	199	177	209	181	165	169
LSZ02	158		175	161	169	168	187
LZS04	215	260	283	299	483	358	626
LSZ05			93			92	
LSZ06	136	204					
LSZ08	169	131	188	195	208	215	197
LSZ11	816	639	403	718	235	230	1072
LSZ12	120	166	160	160		192	173
LSZ13	189	155	213	186	184	203	130
LSZ14	176	154	161	172	158	198	191
LSZ15	195	287	232	135			
LSZ16	140	222	161	159	168		185
LSZ17	219	91	194	250	266	220	260
LSZ28	236	190	179	178	171	160	223
LSZ29	108	68	106	144	119	128	150
LSZ30	486	196	210	102			
LSZ31	114	214		184	208	204	203
LSZ32	167	242	226	224	255	265	224
LSZ33	199	166	210	195	186	130	203
LSZ34	190	205	186	214	206	207	210
LSZ35	120	151	126	137	151	158	150
LSZ36	136	218	202	213	229	185	218
LSZ37	508	403	127		680		
LSZ38	183	239	66	100	54	157	113
LSZ39	140	153	134	161	164	166	162
LSZ40	179	252	221	240	274		246
LSZ42	190	176	159	179	193	217	189
UWBZ01	965	331	332	311	382	439	407
UWBZ02	212	216	236	293	292	284	304
UWBZ04	198	230	209	231	240		229
UWBZ06	166	266	164	196	181	259	197
UWBZ10	144	191	222	214	208	229	192
UWBZ17	242	244	252	275	258	247	256
UWBZ18	336	503	340	97	130	138	233
UWBZ19	197	240	218	209	221	213	237
UWBZ20	112	151	133	123	125	119	131
UWBZ21	114	111	136	106	127	143	123
UWBZ22	109	135	170	149	175	174	194
UWBZ23	176	132	209		129	221	130
UWBZ24	140	142	132	159	152		177
UWBZ26	103	150	131	132	139	124	137
UWBZ27	698	124	116			86	

RED : at or above steam temperature (≥210 °F)
GREEN : below steam temperature (<210 °F)